POPULAR SCIENCE

FOUNDED MONTHLY 1872

MAY

15 CENTS

NOW 15¢

TO CENTS IN CANADA

See Page 47

NRA MEMBER

WE DO OUR PART

NEW INVENTIONS
MECHANICS
HOME WORKSHOP
MONEY MAKING IDEAS
350 PICTURES

Here's how -

MARFAK *follows the gears*

These gears operate at speeds of 3,000 revs. per minute under terrific pressures. Marfak stands up and protects against dry grinding friction.

The effective lubrication of these gears is a tough job. The worm gear is highly efficient, but the severe rubbing contacts quickly squeeze out any ordinary lubricant. Marfak does the unusual. It holds tenaciously to the metal surfaces—refuses to wipe off. It coats and follows the teeth under highest pressures, preserves perfect meshing and saves rapid wear.

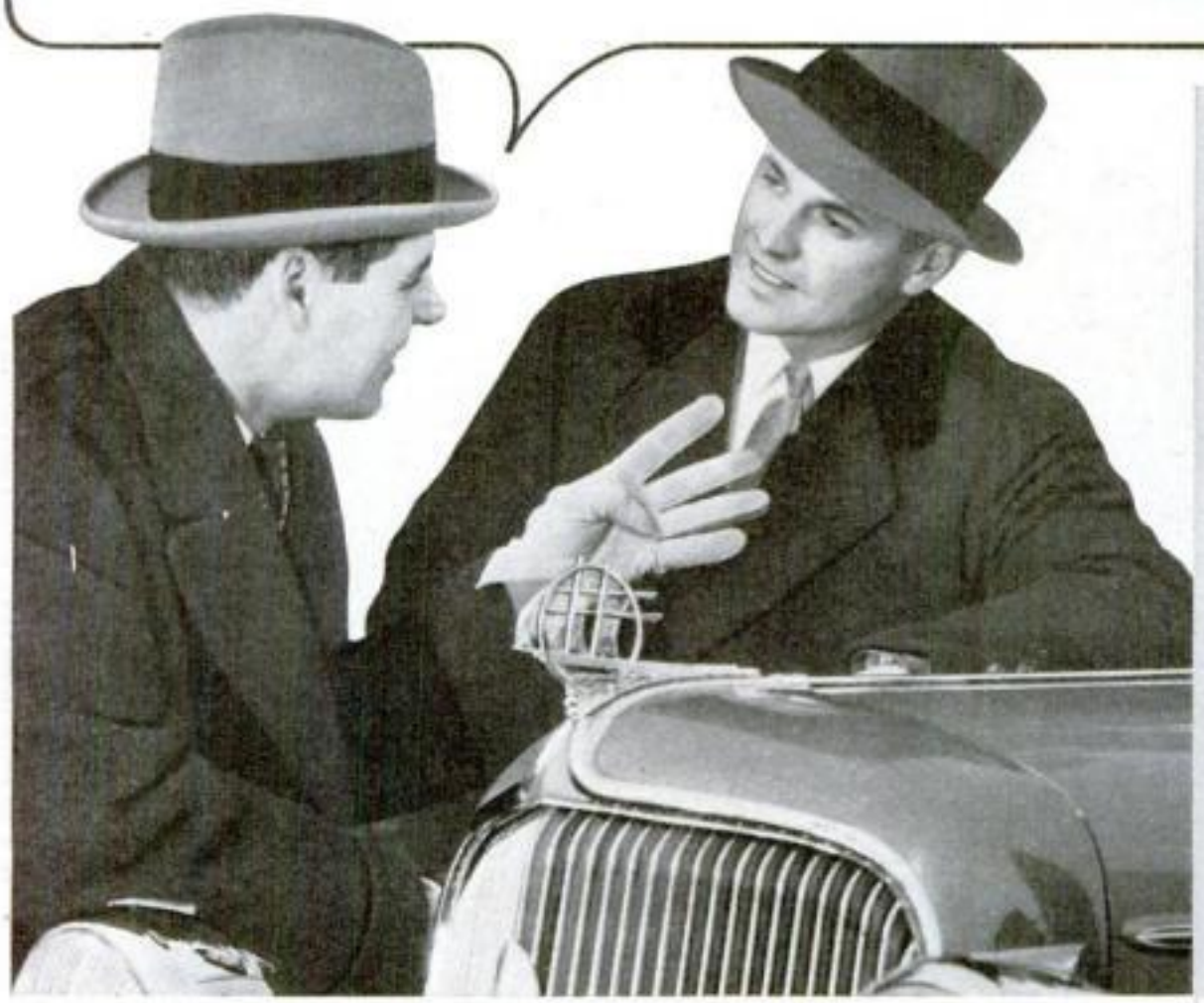
Have *your* car lubricated at a Texaco Certified Station. Marfak for worm drives and chassis parts, or Texaco Thuban Compound for certain types of gears, will mean many thousand extra miles of safe protection, quieter action and a substantial saving in service and repairs. It will be worth your while to make the Texaco Certified Sign *your* guide to better lubrication.

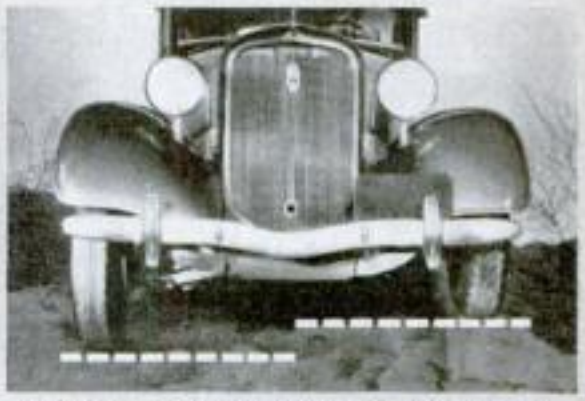
THE TEXAS COMPANY • *Texaco Petroleum Products*

THE TEXAS COMPANY IS THE ONLY COMPANY THAT MAKES MARFAK

TEXACO *Certified* LUBRICATION

"I Got All 4 for My Money!"





A big coil spring "steps" right over bumps in the road . . . there's no axle to transmit shock from one wheel to another.

The water in the glass does not spill with the motor racing. Floating Power engine mountings put an end to motor vibration.

Plymouth is the only Low-priced Car with all these Vital Features

WHY PAY MORE and get less than Plymouth offers? Look at "All Three" . . . get all the facts.

Do you want Individual Wheel Springing . . . the feature that ends nose bounce and road fight? You get it in a Plymouth . . . at a lower price.

Do you want quick-stopping, self-equalizing Hydraulic Brakes? Plymouth, alone, of the low-priced cars, gives you this vital safety feature.

Do you want the protection of a Safety-Steel Body, the vibrationless comfort that Floating Power engine mountings give? Again, check the low-priced cars! Plymouth alone gives you both of these features.

Maybe you didn't know there was such a difference in low-priced cars. It pays to look at "All Three."

Plymouth's safety-steel body means longer life. No joints to rattle—nothing to warp or rot—it's steel *reinforced with steel!*

Hydraulic Brakes . . . are always self-equalizing. They give you quicker, surer stops—without side-skid—and fewer relining jobs!

IT'S THE BEST ENGINEERED LOW-PRICED CAR

LEFT—De Luxe Plymouth Sedan, $650 f.o.b. factory, subject to change without notice.

NEW PLYMOUTH $495 AND UP F. O. B. FACTORY DETROIT

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 124 · NUMBER 5
15 Cents a Copy · $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

TABLE of CONTENTS for MAY, 1934

How Uncle Sam's Scientific Detectives Smash Kidnap Gangs . . 15
EDWIN TEALE *explains why crooks are finding the snatch racket "too hot to handle"*

Phantom Race Horse Produced by Science 18
ARTHUR GRAHAME *tells of a thoroughbred that even Man o' War could not beat*

Racing Midget Autos 26
A new game of speed, thrills—and spills, described by ANDREW R. BOONE

Deadly Snake Poison Saves Human Lives 29
GEORGE COOKE *writes of a new wonder of medicine*

Portable Equipment Makes Whole World a Movie Studio . . . 32
Short cuts and ingenuities in faraway places seen by JOHN E. LODGE

Raising Tropical Birds at Home for Fun and Money 36
FRANK FLOWERS, *professional expert, offers some tips for amateurs*

Slanted Oil Wells Work New Marvels 40
Viewing an important engineering achievement with STERLING GLEASON

Simple Stunts with Balls and Shadows Show How Moon Is Eclipsed 50
GAYLORD JOHNSON *offers more home experiments for amateur astronomers*

May, 1934, Vol. 124, No. 5. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.

Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Buying an Electric Refrigerator . 8
Our Readers Say— 10
Plants in a Microscope Garden . 42
Home Chemical Tests with Drugs 56
Newest Household Aids 58
Regular Set Gets Short Waves . 62
Builds Own All-Wave Portable . 63
Saving Dollars on Your Car . . 64
The Home Workshop 65
How to Take Home Movies . . 72
Useful Short Cuts for Motorists 74

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

Odd Bus Uses Dual Power . . 21
Driver Has High Seat in Truck 22
Racing Car Burns Oil . . . 23
Runs His Car with Diesel Oil . 44
Clock Tells Lighting-Up Time . 49
Weather Reports for Autoists . 52
Plan Modern Car Lighting . . 55
Auto Trailer for Boat 66
Rivet Press Relines Brakes . . 100

AVIATION

Wax Increases Planes' Speed . 20
Plane Motors in Sections . . . 22
View Shows Airship Take-off . 22
Gas Mask for Airship Workers 23
Tree-Top Guns Repel Aircraft 31

POPULAR SCIENCE MONTHLY FOR MAY, 1934

Whirling Lights Help Flyers . 35
New Tailless Flivver Plane . . 39
Plane Wings Support Big Load 45
Turns Bicycle into Glider . . 54
New British Flying Boat . . . 55

ENGINEERING

Tunnel Brings Water to City . 20
First Aluminized Bridge . . . 21
Test Earthquake-Proof Design . 38
Circuit Breaker Has Odd Shape 48
Freight Cars Anchor Tank . . 49
Grill Work Guards Turbines . 53

HEALTH AND HYGIENE

New Radio Knife Invented . . 20
Rays New Fever Test 22
Cod-Liver Oil in Candy Form . 22
New Ultra-Violet Bulb . . . 39
Nicotine Gives Smoking Kick . 45
Painless Hypodermic Needle . 55

MODELS

Model Tow Boat Pulls Punt . 44
Model Wheels from Pistons . . 70
Drilling Jig for Deadeyes . . 79
Lamps Made from Acorns . . 81
Finishing the *Hartford* Model . 82
Building Solid Model Planes . 86
Steel Bridge for Railway . . . 102

NEW PROCESSES AND INVENTIONS

Electric Timer Clocks Swimmers 21
Cellophane Guards Rare Stamps 31
Pressure Sharpens New Pencil 34
New Map-Reading Device . . 34
Renewable Abrasive in Tool . 38
Black Light Guards Baby . . 38
Ribbed Gloves Hold Dishes . 39
New Toy Construction Set . . 39
Miniature Planetarium . . . 44
Grass Cutter Like Golf Club . 44
New Level Has Pendulum . . 45
Pocket Scale Shows Roof Pitch 46
Pusher Moves Freight Cars . . 46
Swinging Car Thrills Riders . 47
Tubing Bent at Any Angle . . 47
Floors Laid without Nails . . 47
Safety Lollypops Invented . . 48
New Device Amplifies Noise . 49
Mechanical Bricklayer 52
Knock-Down Kennel for Dog . 53
Suction Trap for Beetles . . 53
Rifle Bullet Cuts Clean Hole . 53
Flood or Spotlight in One . . 53
Tiny Microscope Aquarium . . 54
Many Play Same Piano at Once 54
Red Glow Marks Burnt Out Fuse 54

PHOTOGRAPHY

Micro-Movies Show Life Secrets 24
80,000 Pictures a Second . . . 31
Electric Camera Runs Itself . 55
Portrait Photos Made Foolproof 72
Photo Contest Winners . . . 95
Original Borders for Photos . . 99

RADIO

Police Get Pocket Radios . . 47
Colored Lights for Radio . . . 49
Earphone Adapter and Switch . 61
Auto Radio Serves in Cottage . 61
New Resistance Indicator . . 61
Airplane Dials for Home Sets . . 61

UNUSUAL FACTS AND IDEAS

Mechanical Legs Carry Rider . 21
Jolting Machine Tests Watches . 21
Drums Beat Code Signals . . 22
Biggest Gold Nugget 23
Octopus Tube of Glass . . . 23
Eleven Carry Seismograph Wire 23
Construct Biggest Fire Break . 34
Furniture from Game Trophies 34
Mold for Biggest Mirror . . . 35
Laborer Finds $315,000 Diamond 35
Mysterious Sea Monster Found 38
Stalactites Form in Subway . . 39
Ship Hits Whale 44
Actor Works at Hobby . . . 45
Machine Explains Business . . 46
Starts Beaver Farm 47
Safety Mask Subdues Bull . . 47
Holes Ventilate Tunnel . . . 48
Coil Offsets Earth Magnetism . 48
Noise Gun May Oust Starlings 48
World's Strangest Dictionary . 49
Handwriting as Character Gage 52
Tower Resembles Battleship . 52
Gas Kills Grape Pests . . . 52
Art Work Made on Porcelain . 54
Chemicals Trap Murder Suspect 55
Home Tests of Scientific Facts 60

CRAFTWORK

Bo-Peep Clothes Rack 68
Modern Looking Bookrack . . 70
Hand-Wrought Hardware . . . 71
Quaint Bird House 78
Handy Pouch for Canoeist . . 88

WOODWORKING

Our Construction Kits 6
Homeworkshop Guild News . 69
Spiral-Turned Table Legs . . 76
Home Workshop Blueprints . . 80

IDEAS FOR THE HANDY MAN

How to Make Electric Chimes . 65
Dripless Watering Can 68
Plywood Top Enlarges Table . 68
Boring Paraffin-Soaked Corks . 68
Forming Roll from Auto Crank 70
Brick Edging Helps Trim Lawn 70
Asbestos Soldering Pads . . . 81
Keeping Paintbrushes Clean . . 84
Holding Wringer Clamps Securely 87
How to Cut Rubber 87
Decorations from Pins 89
Jigs Bend Sheet Metal . . . 94
Coloring Tools Blue 94
Rubber Rim Protects Oilstone . 100
Cementing Sandpaper to Disk . 100
Dippers Aid in Painting . . . 100
Finger Grips for Protractors . 100
Spider-Web Cross Hairs . . . 103
Tools for Delicate Carving . . 109
Water Glass Has Many Uses . 109
Mending Worn Blowtorch Burner 110

"YES, MOTHER. *She's right here*"

AT THE close of the day, at the end of the week, at the turn of the year, when your mind ranges back to sum it up, what counts for most?

Is it not the people you spoke to and what you said to them and what they said to you? The ideas born in conversation, the new slant given to your thoughts by a word or two, the greetings and farewells, the advice and the admonitions, the hopes confessed and questions answered—these and a thousand other vocal expressions make up the story of our lives.

To be cut off from human contact is to live but part of life. The wonder of the telephone is that it multiplies human contacts, restores broken ones, strengthens strained ones and constantly develops new ones. In spite of distance or storm or inability to move about freely, you can be as active, sociable, alert and informed as you wish by telephone.

Just think of this the next time you use the telephone. With no greater effort than the calling of a number or the turning of a dial, you can speak to almost anyone, anywhere. No place or person is far away when you can say—"I'll call you up."

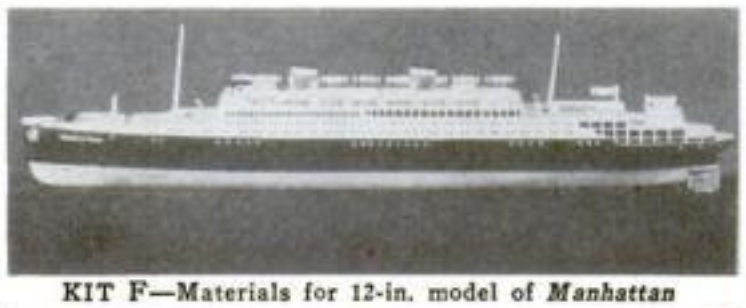
Is this somebody's birthday? Is someone in another town being married or celebrating a wedding anniversary? The sound of your voice and your good wishes will brighten the day. The rates are low. You can make a daytime station-to-station call to most places 75 miles away for about 50c. During the evening and night periods many rates are 15% to 40% lower than in the daytime.

BELL TELEPHONE SYSTEM

Construction Kits

for Ship Models and Furniture

NO. 6



KIT F—Materials for 12-in. model of ***Manhattan***

KIT H

The historic *Hartford*—KIT L

KIT G

KIT D

NO. 4

KIT E

NO. 5

ON EVERY hand you hear hobbies being talked about as never before. There are, of course, hobbies of many kinds, but none is more genuinely satisfying or has more real and lasting value than that of making things with your hands.

"But how am I going to get started?" you may ask. "I have never made anything more elaborate than kitchen shelves and garden trellises, and my only tools are those to be found in the average household tool kit."

The answer is a simple one. Use the Popular Science Homecraft Guild construction kits. First of all, they provide in a single package all the materials necessary to make any one of a number of ship models and pieces of furniture. Second, the materials are in such a form that they save you a vast amount of tedious and relatively uninteresting work. Third, they are inexpensive. Fourth, the materials are of the finest quality. Fifth, there is no waste, and you do not have to buy a larger quantity of anything than is actually required.

The ship model kits contain only the raw materials, although in several of them a certain amount of preliminary shaping has been done on the hulls. In our furniture kits, however, the turning, boring, and other machine operations have been completed. All that remains to be done is the necessary hand finishing and assembling.

All kits are accompanied by instructions or blueprints. The list continues on the following page.

A. Whaling Ship model *Wanderer*. All the raw materials (except paints), Blueprints Nos. 151 to 154, and a booklet. The hull is 20½ in. long.....$6.90

AA. Same with hull lifts sawed .. 7.40

D. Spanish galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet 6.45

DD. Same with hull blocks shaped.. 6.95

E. Battleship model, U.S.S. *Texas*, 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

EE. Same with hull lifts sawed.... 7.45

KIT J

Materials for a miniature clipper ship

NO. 2

KIT A

F. Liner *Manhattan*. All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204. 1.00

G. Elizabethan galleon *Revenge*. All raw materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 209.. 6.75

GG. Same with hull blocks shaped. 7.25

H. Cruiser U. S. S. *Indianapolis*. All raw materials (with enamels) for a simplified 12-in. model, and Blueprint No. 216.. 1.50

J. Clipper ship *Sea Witch*. All raw materials (except paints) for a simplified 13-in. model, with blueprint..... 1.50

L. Farragut's flagship *Hartford*, a steam-and-sail sloop-of-war. All raw materials (except paints) and special Blueprints Nos. 221 and 222. The hull is 33½ in. long, and the over-all length is 41 in..... 7.95

LL. Same with hull lifts sawed ... 8.45

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble, but without finishes..... 5.40

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes.. 5.30

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33¼ in. high. Ready to assemble and stain included 5.75

No. 6. Solid rock maple butterfly table, top 19 by 22 in., height 22½ in. Ready to assemble and stain included..... 6.90

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me Kit.....for which I inclose $..... (or send C. O. D. ☐)

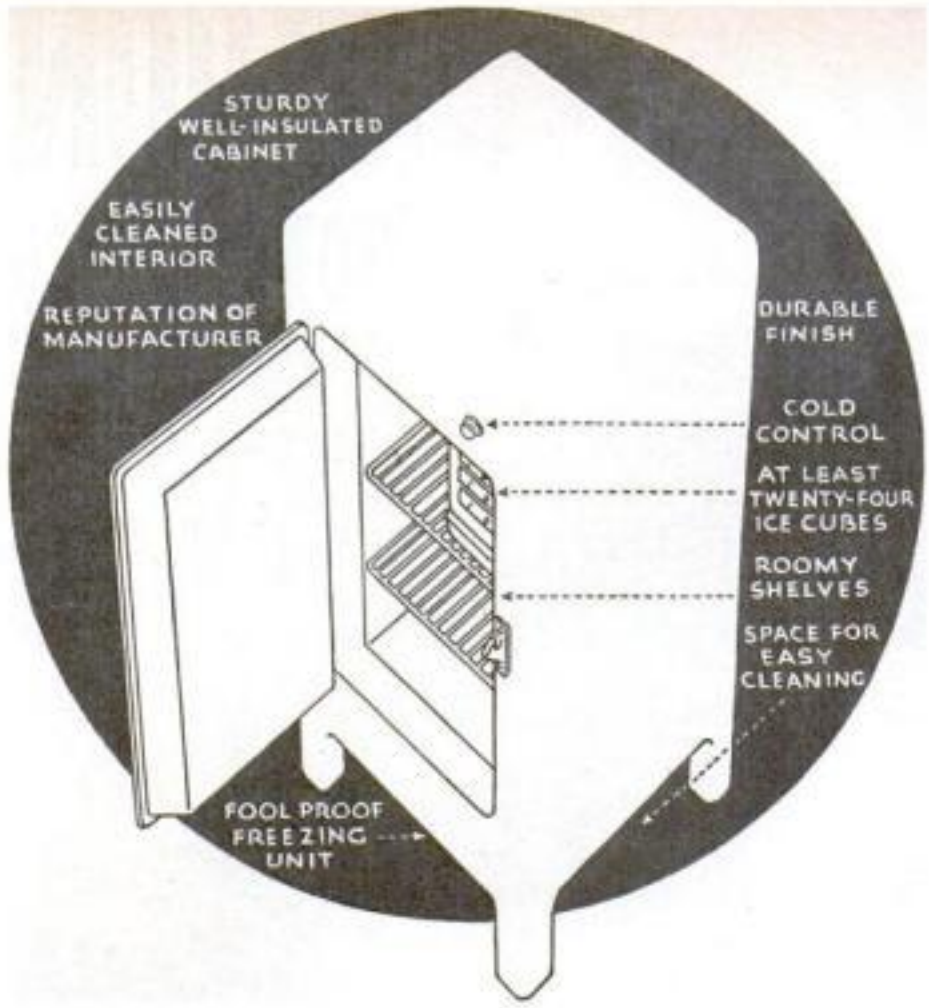
Name .....

Address .....

City..... State.....

(Please print name very clearly.)

Note: Prices of all kits except *F*, *H*, and *J* are 50 cents higher west of the Mississippi River because of heavy shipping charges. We prepay the postage on both cash orders and C. O. D. orders, but if you order C. O. D. you will have to pay on delivery the extra charges made by the Post Office, which amount to 28 cents. Kits *F*, *H*, and *J* cannot be sent C. O. D. This offer is made only in the United States.



• BUYING AN

Electric Refrigerator

THINGS YOU SHOULD KNOW BEFORE INVESTING YOUR MONEY IN AN AUTOMATIC COOLING PLANT ARE CLEARLY SET FORTH IN THIS ARTICLE

By R. M. Bolen

Secretary, Popular Science Institute

EVERY month, Popular Science Institute receives letters from readers asking whether a certain make of automatic refrigerator offers the best value for the money. Many readers cannot decide between two or three well-known makes. Others mention refrigerators whose names are entirely unfamiliar.

To assist these readers, as well as other prospective refrigerator buyers, the Institute has attempted to formulate a number of rules that should simplify the problem and make it an easy matter for any mechanically minded person to make a satisfactory choice.

In the first place, the buyer should acquaint himself with the various types of automatic refrigerators on the market. Roughly, they fall into three classes: the electric type, the gas type, and a comparatively new unit operating on oil. In operation, the general principle governing all three is more or less the same.

Almost everyone at some time or other has let the air out of an automobile tire and noticed the relatively cold air that escapes. In the same way, everyone who has ever had the misfortune to pump up a tire knows that the base of the pump becomes warm. Compression heats a gas and expansion cools it, and it is this swapping back and forth of heat by a gas as it is compressed and expands that serves as the principle of all mechanical refrigerators.

In an electric refrigerator, the refrigerant gas is compressed by a mechanical compressor. In a gas or oil-fired unit, a tiny flame takes the place of the mechanical compressor. The refrigerant gas is dissolved in water. When the liquid is heated the gas is freed so rapidly that in filling the space at the top of the container it becomes compressed.

After compression, whether by mechanical or other means, the refrigerant gas then is allowed to expand quickly and like the escaping air from an automobile tire, it becomes instantly cold.

Obviously, a good automatic refrigerator must have a foolproof freezing unit. To be economical as well as safe, it must be dependable and good for long periods of operation without servicing.

The second requirement of a good re-

frigerator is a sturdy, heat insulating cabinet. Without it, even the best freezing unit will be costly to run. Heat that steals in through the walls or door, offers just that much more resistance to the chilling effect of the cooling coils.

To be convenient as well as efficient, the cabinet must, of course, have incorporated in it certain features. First of all, it should be easy to clean. Its inner surface should be of some material that does not spot easily and the shelves should offer the least possible surface to particles of food that may be spilled.

Besides adequate provision for the making of ice cubes, the automatic refrigerator's equipment should include a vegetable tray and well-planned shelf space. Shelves that are too close together offer a problem when storing tall bottles or large dishes and shelves that are too wide apart mean wasted space and increased operating cost.

Even the method of mounting should be considered when buying an automatic refrigerator. Cabinets placed close to the floor offer a problem when it comes to cleaning under them. It should be possible to pass a broom under the cabinet without too much stooping.

To be most efficient during all the seasons of the year, an automatic refrigerator also should offer some means of cold control so that the rate of freezing can be altered to suit the demands of the weather and the requirements inside the cabinet.

Although the householder can judge the appearance of a refrigerator and its many features, he has no visible way to assure himself of the dependability and efficiency of the unit as a whole. He has, however, one signpost to guide him—the reputation of the manufacturer. The seal of a reputable manufacturer on the cabinet of an automatic refrigerator is proof that the unit has been tested and retested by housewives as well as engineers in an effort to make it convenient and dependable.

Home Workshop Lighting Booklet Now Ready

TO HELP readers improve the lighting in their home workshops, POPULAR SCIENCE MONTHLY has prepared an up-to-the-minute booklet on shop illumination. It will answer your questions about lamps, circuits, and workshop planning and help you to place switches and outlets conveniently. No shop owner should be without one.

To obtain this new booklet, use the coupon below.

Popular Science Institute,
381 Fourth Ave.,
New York, N. Y.

I want your new booklet on lighting the home workshop. Enclosed is ten cents in stamps (or coin). Send it to

.....
Name

.....
Address

.....

Our Readers Say

When Those Happy Days Arrive Will the Road Hog Be Alive?

IF ALL develops as anticipated, every driver will respect traffic laws and signals which will not be nerve-racking bells, confusing, blinking lights, whistles, or hard-boiled cops, but silent electrical waves or beams that will govern the speed of cars in the various zones and stop them at intersections without vigilance on the part of the drivers. Cities will install simple equipment that will charge the various zones with electrical waves that will regulate the speed of cars and stop them at the intersections as required by law. Until such time as all cars are equipped in the factory with the necessary devices, a simple device may be installed in each car that will permit these electrical waves to operate small lights in each car directly before the driver eliminating any excuse for failure to obey regulations. Would it not be bliss to eliminate the annoying bells of stop signals, the worry of watching for lights, the dodging of cars whose drivers do not respect laws or signals? By this electrical system all drivers will automatically be forced to drive sanely. —T. R. S., Van Nuys, Calif.

Read Popular Science and Fixed His Own Camera

I WOULD like you to know that the articles appearing in POPULAR SCIENCE MONTHLY are not published in vain. To mention one instance: In the early part of September my camera fell to the ground, with the result that the focusing scale was thrown out of register. I had about decided to send it to New York for adjusting when an article in your magazine answered the question and I fixed it myself. Tilting tops as you know are expensive; so I am hoping that in some future article you will show how one may be made.—H. S. B., Springfield, Mass.

Reader in British India Asks for Book Reviews

IN REFERRING to several back numbers of POPULAR SCIENCE MONTHLY, I find that rarely do you give a report on the publication of any standard scientific book on any particular subject. Will you very kindly have a department devoted to book reviews in your valuable journal? A list of standard and up-to-date books on the subject discussed in each article printed in POPULAR SCIENCE MONTHLY, also would be a help to those who would like to pursue the subject further.—B. B. J., Post Chharodi, British India.

Adding-Machine Enthusiast Curious About Its Insides

THIS morning, while I was pressing the small keys of an adding machine, and adding up millions of dollars a minute, the thought struck me that, like the telephone and radio and other modern phenomena this generation is so accustomed to, this machine is a marvelous achievement. Why not an article on the mechanism and working of the adding machine, the comptometer, or even an accounting machine? It is surely science, and, I presume, would be of interest to many readers. I have heard that the adding machine runs on the same principle as the speedometer, but I wager few know how the speedometer in their cars work.—G. D. N., Windsor, Conn.

Microscope and Camera Take Picture of Goldfish's Tail

HERE is the description of an experiment performed by the "Experimental Biology Club" of De Witt Clinton High School, of New York City. We used an eight mm. movie camera loaded with panchromatic film. The microscope was a binocular which is the best type to use as you can watch the field while you are photographing. The camera was lowered onto one of the oculars, care being taken to see that it was in a straight line with the barrel. Next, a piece of black cloth was wrapped around the point where the camera lens and the ocular met to prevent any possible light leakage. Then the subject, a goldfish, was placed under the microscope, its head and gills wrapped in water-soaked cotton. The goldfish was moved so that the thin part of its tail was under the lens. Since the lens did not possess a focusing mount it was necessary to open the lens to its largest aperture, F:3.5. Now a beam of sunlight was allowed to fall on the mirror of the microscope and reflected through the stage. Then we focused the microscope by looking through the other ocular. Then we "shot."—H. S., New York, N. Y.

Dust in Air Causes Those Bewildering Moving Shadows

IN A recent issue of POPULAR SCIENCE MONTHLY I read the article from E. W. J., Van Buren, Mo. It seems to me that the only logical answer to his problem would be the dust in the air. We all know that air is made up of a combination of gases and that these gases are invisible. We also know that heat causes convectional currents in this air. Now there is always a certain percentage of dust suspended in the atmosphere and that percentage is relatively higher in a house than outside. Then as the hot air over the radiator rises, the dust suspended in the air also rises and in getting between the sun and the floor it casts those moving shadows since the dust itself is moving. A blast of cold air will stop the motion for a minute since the cold air will stop the current of rising air.—J. W. R., Plattsburgh, N. Y.

Natives of Australia Still Throw Spears with Womerah

IN AN interesting article by Robert E. Martin, in a recent issue of POPULAR SCIENCE MONTHLY, a native is shown in the act of throwing a spear, and as far as I can understand he is propelling the weapon by means of a short handled throwing stick. In the Northern part of Central Australia, where the blacks are still uncivilized, they use the weapons of their forefathers, and among them is what is called a "Womerah." This is a handle into which the handle of the spear fits loosely. With the Womerah, the black man can propel his spear very accurately and for a relatively great distance. The picture in your magazine is posed in exactly the selfsame manner as the Australian poses when using his weapon. Yours is the best magazine I have read in many a long day.—J. S., Plumpton, N. S. W., Australia.

He Answers One Question And Then Asks Another

IN ANSWER to the question of A. H. W. concerning the letting in of ultra-violet rays by a rocket plane, the ozone, unquestionably, flows back over the rupture. Now the question that I would like to ask is how to protect the passengers of a space ship from the ravages of these same short ultra-violet rays?—S. V. F., East Cleveland, Ohio.

His Theory Says Light from Moving Object Comes in Curve

WHEN reading Our Readers Say in a recent issue of POPULAR SCIENCE MONTHLY, I came across something on light which reminded me of a pet theory of mine. Here it is: Light from a moving object, like a star, does not travel in a straight line. As the star moves, it sends out light, so that the position of the source of the light may vary by several million miles. Directly comparable to this, I think, is a hose with water coming out of it. If the hose is moved around, the water comes out in an

Step into your *own* barber shop!

LIFT the lid of this box and you open a private tonsorial parlor. All the professional deftness and skill of the expert barber are *shaped* in Gem's modern design.

The straight, slant-top frame presses the slack out of flesh folds—tightens the skin like a barber's stretching fingers, and brings all bristles against the blade at right angles and *root level.*

Gem moves with the barber's swift, tugless, *face-length* glide. It gets *all* the stubble with a *once-over* that leaves the wiriest chin trig and trim for twenty-four hours.

Only Gem can give such a shave, because Gem controls the patents on Dual Alignment, which makes it absolutely *safe* to use the *sharpest* blades on earth. Thick beards that take the heart out of fragile, shallow edges can't *hold out* against the 50% *thicker* surgical steel, which Gem strops 4840 times to produce a scuffless, *ouch-proof* blade.

We give Gems a deep, tapered *wedge-edge* that Dual Alignment locks unbudgingly at *five points*. Gem Micromatic Blades last *so* much longer that substitutes are a penny-pinching extravagance. Gem Razors last *forever.*

Made in one piece with no take-down parts. Gold-plated sets—$1 *anywhere*. Or a trial kit with Gem's latest razor and two blades, for *your quarter* and our coupon.

CLIP

Gem Safety Razor Corp.,
Dept. PS21, Brooklyn, N. Y.
Enclosed find 25c for complete trial Gem set with a single- and a double-edge blade and the same gold-plated Gem Micromatic Razor now featured in regular $1.00 outfits.

PRINT NAME .....

ADDRESS .....

GEM MICROMATIC *Razor and Blades*

arc. I think the same thing would be true of light. On the earth, however, the theory might not work, but I think it should. What do you readers think?—A. H., Glen Ellyn, Ill.

Homemade X-Ray Machine Is His Modest Desire

I WOULDN'T trade my copies of POPULAR SCIENCE MONTHLY for any other periodical on science. I have them all bound in your special covers, and I think it's the best reference library there is. For every volume that holds twelve issues I have compiled my own complete index, which I pasted on the inside of the cover. Please publish an article on how to construct a simple X-ray machine without having to purchase any expensive equipment. I also think you should have more articles on how to build Oudin, Tesla, and other kinds of experimental induction-coil apparatus with an explanation of their phenomena.—M. P., Brooklyn, N. Y.

In This Strange Land Moon And Rainbow Shine at Night

IN A recent issue of your magazine under the caption "Why a Rain Bow? Isn't a nice Moon enough?" L. M. G. of Lewiston, Pa., wants to know if any one has ever seen a rainbow at night? If L. M. G. will make a trip to El Volcan in the Republic of Panama, three hundred and fifty miles from the City of Panama, during the months of January, February, March or April and there await moonlight nights he can see real rainbows at night and full moons too.—T. C. J., Balboa, Canal Zone.

One More Free-Will Editor Tells What He'd Like

IT SEEMS as if every one of your readers has some suggestion or other to make toward making POPULAR SCIENCE MONTHLY suit them better. So, falling in line with the rest, I present my idea of a better magazine, (if possible). From time to time I have noticed letters from your readers asking for articles on dirt-track racers. It is my idea that such articles would be appreciated by many. Let's have more like Martin Bunn's articles. Now that almost everyone has his own car I am sure they would like to know more about them. Discuss more fully the new improvements, like individual wheel suspension, automatic clutch, twin ignition, etc. Give us articles on converting older cars into dirt-track racers.—T. B., Louisville, Ky.

He's Lost in an Atom and Too Worried to Sleep

I'M IN plenty of trouble and in serious need of help. The thing that gets me is this: Is our universe a giant atom? You have often seen pictures of atoms showing their structure, and you have also seen pictures of our universe showing how it is made up of suns and planets. Have you ever stopped to compare these two pictures? Well, I did, a long time ago. And I have not had a good night's sleep since. I hope some reader can solve this problem and relieve my anxiety so I can sleep.—H. M. McN., London, Ont.

Diameter of Chinese City Is Found to Be Nine Miles

I AM writing you regarding the problem presented by C. D., Courtenay, Can., in Our Readers Say department in a recent issue of the POPULAR SCIENCE MONTHLY. I solved the problem by two different methods obtaining the answer of nine miles for the diameter of the city by both the geometric and the trigonometric methods.—K. B., Saginaw, Mich.

Amateur Chemists Voice Approval of Our Articles

I AND other amateur chemists appreciate the article in the issue of March, 1934, of POPULAR SCIENCE MONTHLY on Home Laboratory Tests, so please keep up the good work. We would also appreciate articles on blow pipe analysis or on static electricity. I agree with J. F. W. who wants articles on high-frequency apparatus, induction coils and static-electric machines.—A. B., Corning, N. Y.

Suggests Use of Compressed Air To Keep Waves Away from Ship

IN A recent issue of POPULAR SCIENCE MONTHLY, I read in Our Readers Say a description of a gunboat that was once propelled by water forced from the stern. This reminded me that I read, some years ago, of the use of compressed air to break up storm waves and effectively protect the coast. I think the experiment was tried at Galveston, Texas. Now all of this makes me wonder if compressed air could not be projected before the bow of a boat to help it when breasting heavy seas. I suggest that a pointed projection beneath the waterline, with the air passing out at the top, would be most effective.—G. H. J., Scarboro, Ont.

Modern Tinkering at Hobby Put into Modern Verse

BE A hobby man,
That's the kind of a guy I am,
An individual thinker
Therefore, like to tinker.

Finding outlet for creative urge,
Makes the blood through my veins surge;
Sometimes it's the artists' lure—
Although pictures are a blur.

Then again, music, composition,
Journalism beckons;
But oh! Materialism reckons:
Come down to earth from spiritism.

Your body also needs attention,
So the basement we now mention,
For there, thanks to a hobby mere,
We have on the cement floor painted
A shuffle board, all colors tainted,
On which to vie our skill and boredom kill.

And so to the wide, wide world I say,
"The happiness a hobby brings, the tinkering family sings."—L. V. G., Chicago, Ill.

Evolution and Surgery Were His Pet Articles

YOUR magazine is one which is read from cover to cover at our house and I receive many suggestions that work to make and save money in our factory. The outstanding articles which I enjoyed in the past have been the series on the evolution of man and the ones about the practice and development of surgery written by Dr. Damrau.—S. M. J., Middlefield, Ohio.

A Mysterious Thing is a Ring on a String

IN AN old book, published in 1892 by W. P. Bullard & Co., Boston, Mass., the following item appears under the mysterious title, "Fireside Mesmerism." "Take a gold ring, the larger the better. Attach the ring to a *silk* thread about twelve inches long. Fasten the other end of the thread around the nail joint of your right fore-finger and let the ring hang about one-half inch above the surface of the table, upon which you rest your elbow to steady your hand. Hold your right fore-finger horizontally, with the thumb thrown back as far as possible from the rest of the hand. If there be nothing on the table, the ring will soon become stationary. Place some silver, say three half-dollars, immediately below the ring. The gold ring will begin to move, backwards and forwards, to you and from you. Now bring your thumb in contact with your fore-finger and the movements of the ring will become transverse to their former swing. Or, the same transverse movement may be effected by having a lady take hold of your disengaged hand. When the transverse motion is fairly well established, let a gentleman take hold of the lady's disengaged hand and the ring will change back to its original course." I tried this before a group of people with success but, so far, have been unable to locate anyone who can explain it. I will greatly appreciate an explanation by one of your readers. I will also appreciate having information on what difference it makes whether a lady or gentleman takes the hand of the experimenter.—G. P. K., Cleveland Heights, Ohio.

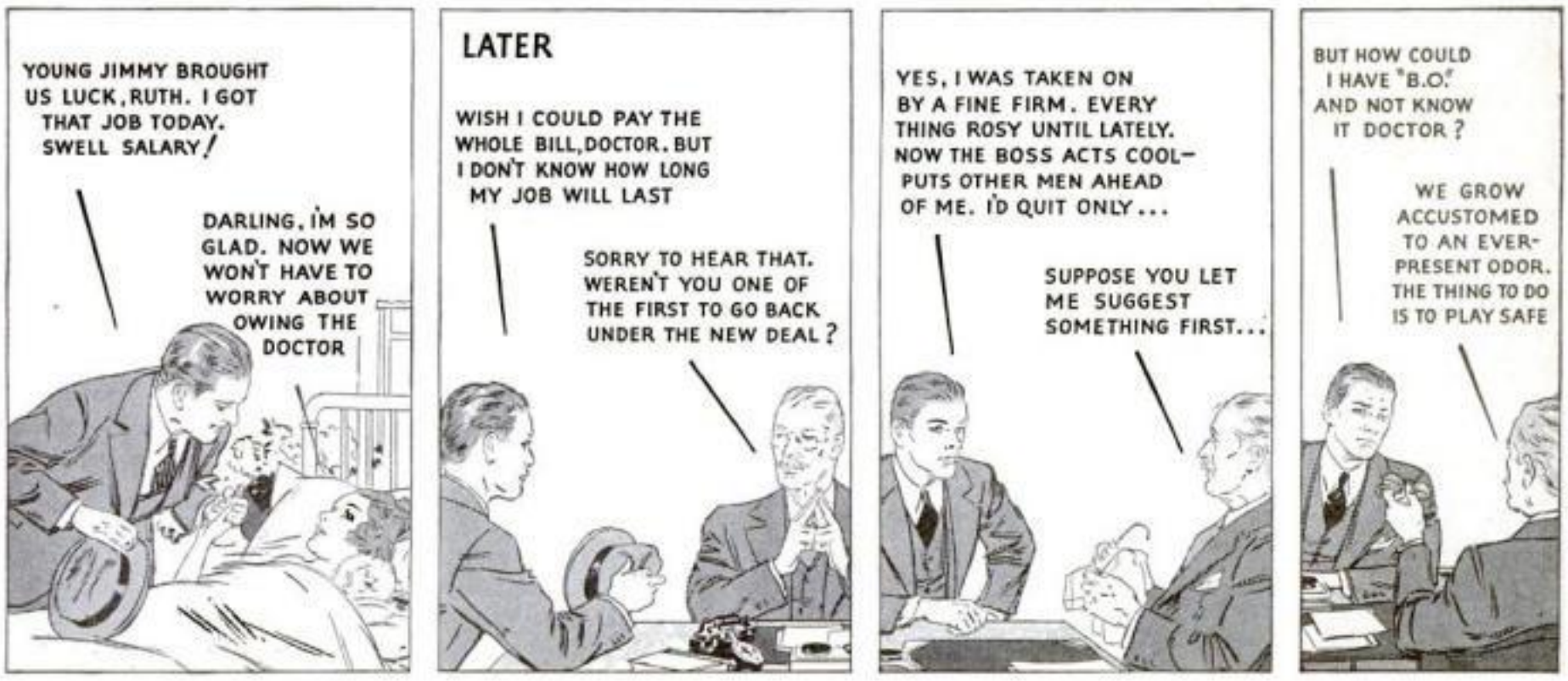
Space Born as Exploding Atom Created the Universe

IN REPLY to R. D., Jr., I should like to say, that according to the famous Abbe Georges LeMaitre's theory, the entire universe was formed as a result of the blast of a giant atom, and before this atom exploded, space had not come into existence. Formerly there were theories that stated the planet Mars was inhabited, but recent investigations show there is no life on that planet or on any other planet in the solar system. There may be, however, life elsewhere in the universe.—W. B., Folcroft, Pa.

If You Bury the Knockers, You Take the Joy out of Life!

IT WOULD be a fine idea if all the fault finders that complain about articles in POPULAR SCIENCE MONTHLY were placed end to end six feet under ground in the Sahara Desert. I read all your pieces with interest, and can hardly wait for the first of the month to come. I take two other scientific magazines, but find that POPULAR SCIENCE is the best of all. I am very much interested in radio, and would be grateful if you would publish an article on how to build a midget all-electric set, using four or five tubes.—S. B. S., Watertown, Conn.

BABY JIM'S ALL PAID FOR NOW



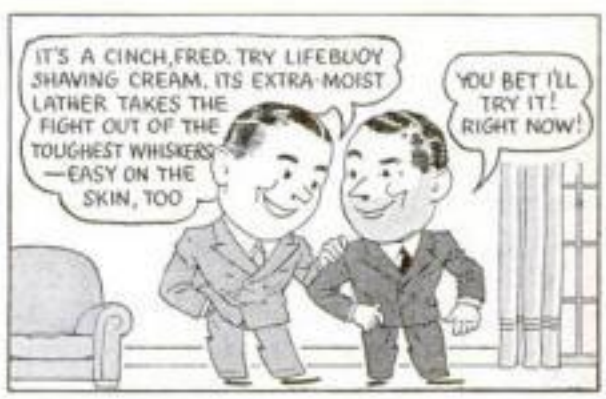
KEEP your complexion *young*—softly sparkling, crystal clear. Difficult? Expensive? Not with this simple, refreshing "home" facial! Work up a rich Lifebuoy lather. Massage it well into pores; then rinse. Do this nightly—see skin bloom with health. Your turn now to enjoy a radiant, *Lifebuoy* complexion!

Facts about "B. O."

We all perspire a quart a day. We grow accustomed to the odor—offend *unknowingly!* Play safe—bathe regularly with Lifebuoy. Its purifying lather *deodorizes* pores—stops "B.O." (*body odor*). Its fresh, clean, quickly-vanishing scent tells you Lifebuoy protects!

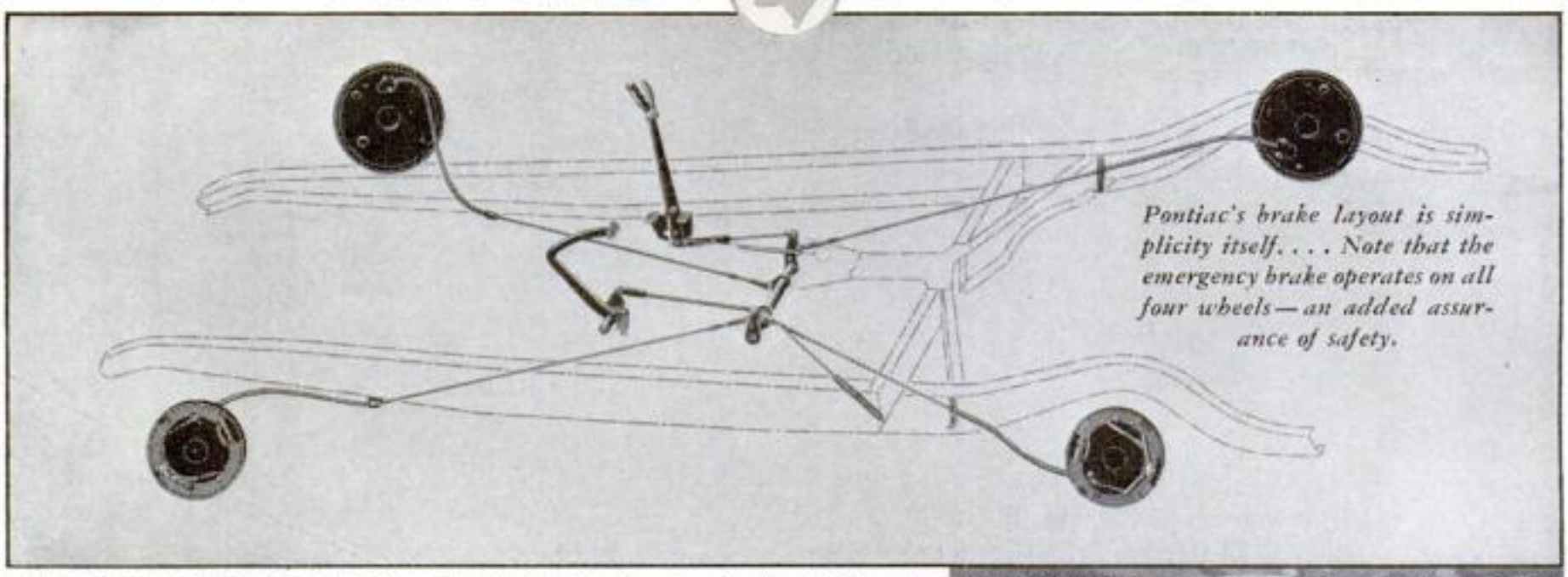
A PRODUCT OF LEVER BROTHERS CO.

SNAPPY SHAVES ARE HERE AGAIN!



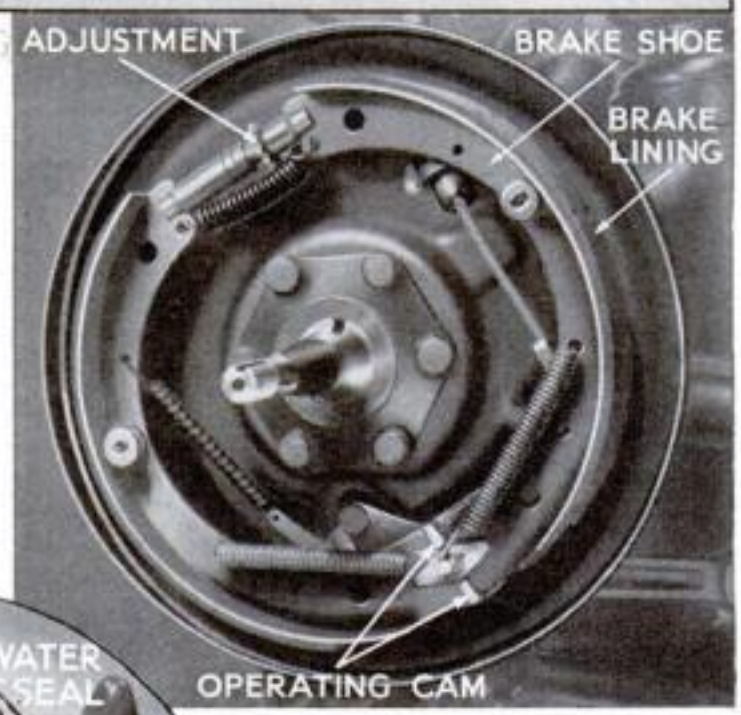
Send for a FREE Trial Tube

Try Lifebuoy Shaving Cream. Get the big red tube at your druggist's. Or write Lever Bros. Co., Dept. A145, Cambridge, Mass., for a free 12-day tube. (*This offer is good in U. S. and Canada only.*)

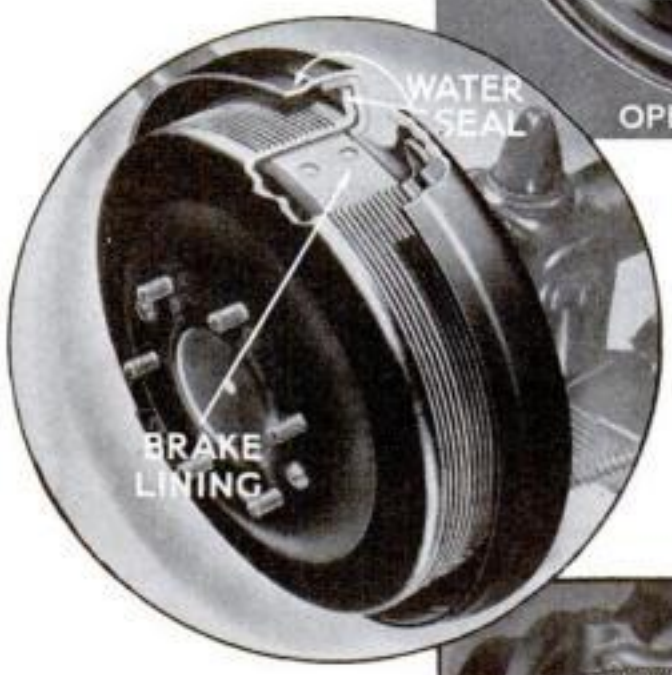


Pontiac's brake layout is simplicity itself. . . . Note that the emergency brake operates on all four wheels—an added assurance of safety.

Pontiac Brakes *are* Simple, Positive . . . *SAFE!*



Pontiac brake drums are 12 inches in diameter and linings are 1¾ inches wide. The two shoes fill almost the entire circumference of the drums. This gives Pontiac 182 square inches of braking surface.



Running around the outer rims of the high (.75) carbon manganese steel drums are ribs which strengthen the drums and pass off heat when brakes are applied. Note, also, the seal against water at the inside edge of the drums.

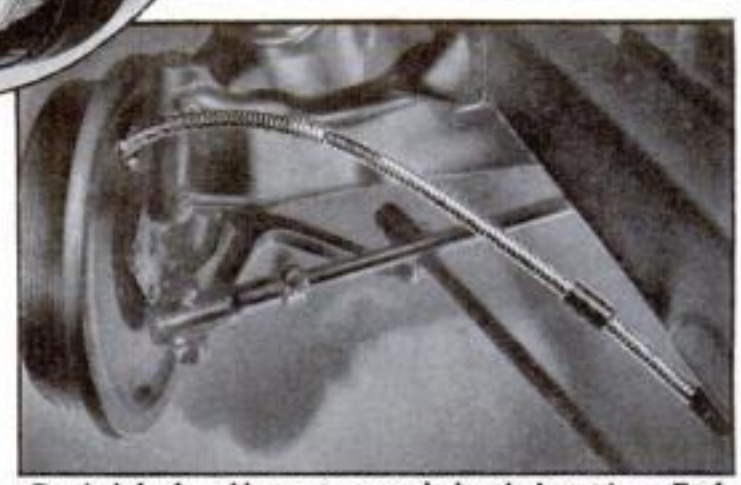
NEW BRAKING SYSTEM CONSIDERED THE FINEST IN THE AUTOMOBILE INDUSTRY . . . .

NO MOTOR car is safer than its *brakes*—and so Pontiac has adopted for 1934 a system that is recognized by automotive engineers as the simplest and most dependable in the entire automobile industry.

Pontiac's Bendix mechanical brakes provide the surest and safest method of controlling deceleration in use today. Their action is fully equalized—not by so-called "equalizers" located at some point in the linkage, but at the point of final action, within the drums themselves. Due to Servo action, slight pressure at the brake pedal is multiplied many times at the wheels. Thus, the car stops quickly, smoothly and evenly at a light touch of the driver's foot.

Pontiac's Bendix brake "hook-up" is the least complicated of any system in the industry. It consists, in its essentials, of brake assemblies, operating cables, rocker shaft, rod to brake pedal and the pedal itself. Due to extreme simplicity, there is practically *nothing* to get out of order. But if a mishap *should* occur to one cable, the entire system would not be put out of commission—there would still be three effective brakes. As a matter of fact, you could saw the rocker shaft completely in two and still have braking power on all four wheels, if both foot pedal and emergency pedal were used.

Owners of the 1934 Pontiac thus have the assurance that the smooth, quick, *safe* action of their brakes complements the new power and speed of the famous Pontiac Straight Eight engine. Pontiac Motor Company, Pontiac, Michigan.



Pontiac's brake cables are pre-stretched and of one piece. Each will stand a strain of over 3000 pounds. In fact, a Pontiac Coupe could be safely lifted by a single cable. From frame to wheels, cables are enclosed in a flexible conduit packed with grease.

Get a Straight Eight for your money!

POPULAR SCIENCE
MONTHLY

May 1934 Vol. 124, No. 5

RAYMOND J. BROWN, *Editor*

HOW UNCLE SAM'S

SCIENTIFIC DETECTIVES SMASH Kidnap Gangs

Above is a typical kidnaper's note. At right, the removal of a $200,000 ransom note from beneath a trash barrel. Kidnapers delight in negotiating with seemingly illiterate communications of this kind mysteriously delivered to strange places

Above, shack where Charles F. Urschel was held by kidnap gang. At right, "Machine Gun" Kelly and his wife Kathryn receive life sentences for the Urschel crime

"MAKE kidnaping such a dangerous, hazardous racket nobody will every try it again."

That was the assignment handed some twenty months ago to the Department of Justice. It set in motion the greatest crime offensive of a generation.

A wave of kidnapings was sweeping the country when, in the spring of 1932, the so-called Lindbergh Law loosed the Federal detectives. What followed comprises one of the most thrilling chapters in the history of police work.

John Edgar Hoover, Department of Justice chief and nemesis of kidnapers

Of twenty-four kidnaping cases recorded since June, 1932, only one remains unsolved! Fifty-three snatchers have been convicted. Eleven are behind the bars for life. Two have been condemned to death. Three have committed suicide. In a majority of cases, the crimes were solved in thirty days and in many instances the kidnapers were on their way to the penitentiary in less than two months. In this spectacular manner, the government has cracked down on the kidnap racket.

Behind this dramatic activity, with its rapid-fire convictions, is the dynamic personality of the head of the Division of Investigation of the U. S. Department of Justice, John Edgar Hoover.

One recent morning I sat for nearly two hours in his office in Washington, while he told me how kidnap gangs are run to earth. Later, I went through record files, followed the investigations in a score of cases and watched men at work in the scientific crime detection laboratory which has played a part of ever-increasing importance in the investigations.

While I talked with Hoover, reports were flashing in from twenty-five key cities in the country. They carried isolated bits of information, tips, rumors. They appeared of little consequence, individually. But to the high command of this crack army of law enforcement, they were like the pieces of a jig saw puzzle. They fitted

By EDWIN TEALE

Picture Story of the Solution of a Famous Kidnap

The armed kidnapers seize their victim as he is playing bridge with friends at his home

The kidnaped man's family starts the man hunt by phoning the Department of Justice

A friend of the victim delivers the ransom money and the kidnaped man is released

together and made sense; they interlocked and gave clues. And they formed a tightening loop of evidence closing in swiftly on a midwestern gang of snatchers.

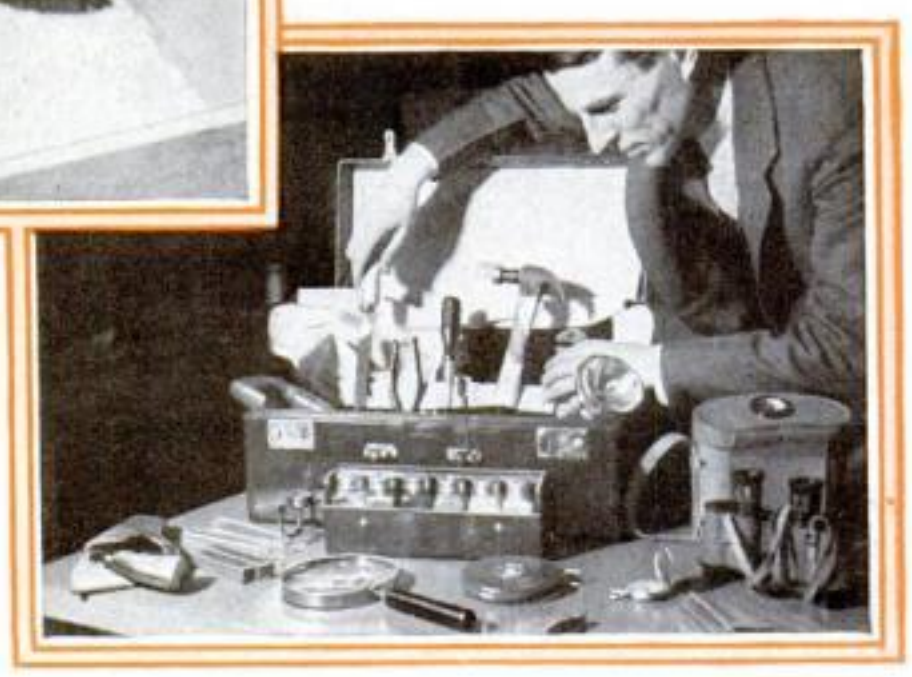
Thirty-six hours later, as my Pullman rushed through towns on the way back to New York, the last piece of the puzzle had been fitted in place. Newsboys were crying this latest feat of the Federal men. Headlines were telling of another success in the job of making kidnaping "too hot to handle."

"We sit here," Hoover had said, "putting such jigsaw puzzles together. We perform no miracles. But we work hard, we keep on our toes, we use every new development in crime detection that will help us in our work!"

Mark the last point. Gangsters, he believes, have been able to outdistance the police because law enforcement officers have not kept abreast of criminals in technique. His annual report, citing the sensational achievements of 1933, calls the outstanding development of the year the increased emphasis put upon scientific methods. In fact, so valuable is this phase of the work considered that when the department moves into its new quarters early this summer, the entire top floor of the huge Department of Justice building will be given over to a fingerprint and scientific detection laboratory. Special equipment is being installed for research and experiment.

Ever since the Division took up the trail of the kidnapers, a skeleton staff has been on duty in Washington twenty-four hours a day. A special telephone switchboard and a "kidnap number," *National 7117*, aids in split-second communication with the proper officials. This number is now listed in directories in various sections of the country as part of the offensive against the snatch gangs. In the celebrated Urschel case of Oklahoma, for example, the details of the kidnaping came in over long-distance wires at one o'clock in the morning, ten minutes after the crime was committed. This gave the investigators a flying start on what proved to be one of the most brilliant feats of crime detection on recent record.

With this box, the detectives learn to recognize the imprints of different types of shoes



Federal detectives carry in ordinary traveling bags, as at right, complete tool kits for use in scientific police work

Late one Saturday night, Charles F. Urschel, an elderly and wealthy oil man of Oklahoma City, was playing bridge with friends on a screened-in porch at the side of his home. Two men suddenly appeared outside. One carried a machine gun, the other a pistol. They ordered Urschel into a small sedan and sped away.

A few days later, a telegraph messenger delivered a package to one of Urschel's friends in Tulsa, Oklahoma. It contained a letter in the handwriting of the captive and a typewritten note instructing the friend to obtain $200,000 in used twenty-dollar Federal Reserve bills and to insert the following advertisement in the Daily Oklahoman: "For Sale: 160 acres of land, good five-room house, deep well. Also cows, tools, tractor. $3,750.00 for quick sale."

The ad was run and the next day a special delivery letter arrived by airmail from Joplin, Mo. It directed Urschel's friend to pack the money in a light-colored leather bag, take the 10:10 P.M. train for Kansas City, and sit with the bag on the observation platform. He would see a large bonfire on the right side of the track. It was the cue to get ready to throw off the money. He was to toss it to the track immediately after passing a second signal fire. In case of any hitch, he was to register at the Muhlebach Hotel, in Kansas City, as E. E. Kincaid of Little Rock, Ark. As he saw no fires, he went to the hotel where he received a telephone call directing him to walk west on a certain block. He had proceeded only a dozen paces when a man approached, said: "Mr. Kincaid, I will take the bag. The deed to the farm will be delivered within twelve hours," and disappeared around a corner. The next day Urschel was home.

During his imprisonment, Urschel had kept his wits about him. He had no idea of the direction in which his captors had taken him, but was able to estimate roughly the distance he had traveled. Blindfolded with adhesive tape, he had heard guinea hens and hogs outside the house where he was held captive; he had been given water with a strong mineral taste in a tin cup without a handle and he had heard the creaking of a pulley as the water was drawn from the well near

Case Illustrates Methods of Federal Detectives

Twice a day, the victim noted, airplanes passed over the house where he had been held

Detectives study maps and flying schedules and at last learn where the victim was held

An early morning raid takes the kidnapers by surprise and results in the gang's arrest

the house. But most important of all, he had heard the roar of an airplane engine passing over the house in opposite directions twice a day, at about 9:45 A. M. and 5:45 P. M. One day it stormed and the plane missed its morning run.

Quickly, the agents got in touch with all airlines operating within 600 miles of Oklahoma City. At the office of the American Airways, they discovered its planes had made two trips daily to Fort Worth, Tex. They had been on schedule every day except one. Then the pilot had run into a storm over northern Texas and had swung far to the north. These planes passed near Paradise, Texas, at about the hours noted by Urschel. A further check-up showed that the mother of Kathryn Kelly, wife of the notorious ex-convict, George R. "Machine Gun" Kelly, lived on a farm near Paradise.

Special agents of the Department of Justice are adept at seeming what they aren't. Among them are experts in sixty-four lines of work and in sixteen sports. One, dressed as a wandering laborer, risked his life to visit the farm. While inquiring about work, he noted a well beside the house and a tin cup without a handle on the ground nearby. Before he left, he helped himself to a drink. The well pulley creaked and the water had a strong mineral taste.

At dawn, Federal men and police officers swooped down on the farm. Before a man sleeping on a cot in the yard could reach for two automatics and a machine gun which lay beside him, the raiders had him covered. He was Harvey Bailey, one of the most desperate criminals of the Southwest. In his possession was $700 of the ransom money.

By the time the case was closed, fifteen members of the gang had been sentenced, six to life imprisonment. The government sleuths had followed the trail of the kidnapers through sixteen states and had covered a territory as large as the whole of Central Europe!

The catching of Machine Gun Kelly and his wife was an epic in detective work in itself. For three weeks, the fast-moving Federal men were just one jump behind the fleeing outlaws. On the day before they raced by plane to Memphis, Tenn., and made their catch, Kelly was reported hiding in five different cities in widely scattered parts of the country.

The government service is organized to track down such rumors at a moment's notice. Every effort is made to save seconds in getting under way. One machine which has figured prominently in most of the cases, is a long black mechanism through which stream perforated cards. Each card represents a noted criminal; each perforation an identifying characteristic.

Thus, if a kidnaping witness reports an unknown snatcher was six feet tall and had a broken nose, the description is flashed to Washington. A few minutes later, thousands of cards are rushing through the black machine. It kicks out automatically every card standing for an underworld character who is six feet in height and has a nose that has been broken. In thirty minutes, it sorts more cards than a roomful of clerks could run through in a day. And, when this chattering mechanical brain has completed its task, the number of suspects has been narrowed to a handful.

Reserved for emergencies, is another new mechanical aid. When dial telephones were introduced, it was found that the usual wire- *(Continued on page 111)*

If a kidnaping victim can describe his captors, this amazing machine will automatically sort out the police records of all known crooks who resemble them, thus narrowing the search

With dial phones, tapping the wires lets detectives hear conversation but does not disclose the number called. With the new device at the left, the number dialed is automatically recorded as Department of Justice men listen in on the telephone messages of crooks who are under investigation

Phantom Race Horse

PRODUCED BY SCIENCE

ARTHUR GRAHAME *Tells, in this Article, How Speed Performances of Great Thoroughbreds Are Measured by Comparison with a Standard Animal Devised by Involved Formulas*

IN EVERY horse race there is an invisible entry, an added starter whose name does not appear on the program and who is never seen by the excited race-goers in the grandstand. This entry is a ghost horse, sent to the starting post by science.

Man o' War, almost any racing man will assure you, is the greatest race horse ever bred in America, the greatest race horse ever bred anywhere in the world. Against his visible thoroughbred rivals, he won twenty of the twenty-one races he ran in the short course of his two-year racing career. But against the ghost horse he didn't do nearly so well. In nine races, he beat the invisible entry. In twelve races, the ghost horse beat him!

This ghost horse is science's contribution to the grand old sport of kings, the mathematical Standard Horse against which the relative quality of all race horses of the past, the present, and the future may be checked. Except that he is more scientifically devised and put together, the Standard Horse is to the turf what Old Man Par is to golf.

Recently, Dr. Harry H. Laughlin, of the Department of Genetics of the Carnegie Institution of Washington, announced the results of his ten-year investigation of the racing capacity of the thoroughbred horse. The Carnegie Institution, whose mission is the advancement of pure science, of course is not interested in horse racing as a sport, nor in the practical aspect of breeding faster horses. Neither, in his scientific capacity, is Dr. Laughlin. His business is the study of heredity, and in the course of his long study of the transmission of racing capacity from one generation of horses to another, he has invented and developed highly valuable scientific tools for the more important study of heredity in man.

Dr. Laughlin chose the field of the thoroughbred horse for his investigation because it is a happy hunting ground for the scientist in search of the facts of heredity. Race horses are bred for a single purpose—to run and win races. Ever since, 300 years ago, King Charles II of England sent his master of horse to the Near East to buy the Barb and Turk stallions and brood mares that became the forebears of our blue-blooded racing stock, the breeding records of the thoroughbreds have been kept with extreme accuracy. For more than 150 years in England, and for almost as long in America, racing records have been kept with the same care. Whether a race horse is a Kentucky Derby winner or a selling plater, digging into the racing records and the stud book will tell you how successful he has proved himself at the job for which he was bred, who his ancestors were, and how successful they were.

Much of Dr. Laughlin's experimental work has been done at the Mereworth Stud, a Kentucky breeding farm owned by Walter J. Salmon, a wealthy New Yorker who is a keen horseman. Salmon also has contributed generously to the upkeep of the Carnegie Institution's laboratory at Cold Spring Harbor, Long Island, where the endless mathematical work demanded by the study has been done.

WHILE a search through the racing records will bring to light the competitive performances of any horse, much hard work was necessary to devise a formula by which the worth of these performances could be measured with scientific exactness. It finally was decided that the most nearly accurate results could be obtained by creating a Standard Horse by mathematical calculation of the best racing records, and then comparing the performances of flesh-and-blood horses with the ghost racer.

At first glance it seems that the creation of the Standard Horse should have been an easy task. Equipoise's world record for the mile is 1:34 2-5. That, it would seem, should be the mile time for the Standard Horse. But in measuring racing capacity, factors other than distance run and the time it is run in must be considered. When Equipoise set his record he was four years old, and he carried 128 pounds. What should his time for the mile have been if he had been six years old, and

if he had carried a lighter burden of only 120 pounds?

It was necessary that the Standard Horse should be an elastic racer whose performances would take into account distance, time, age, sex, and weight carried, so that he always would be a fair yardstick for the measurement of the performances of real thoroughbreds running under the varying conditions of actual racing.

THE four main factors affecting the speed of race horses were studied exhaustively. Analysis of many hundreds of records showed that, while increasing the length of a race always slows down the average speed of the horses running in it, this slowing-down process is rapid for each furlong, or one-eighth mile, added to the shorter distances, but much less rapid for each furlong added to the longer distances.

Age was found to be an extremely important factor in racing capacity. Race horses improve until they reach a certain age, and then gradually decline in ability. Fillies improve until they are about two and one-half years old, colts until they are four or four and one-half years old, and geldings until they are about five and one-half years old. So there are two ages for a given racing ability in the same horse, a "coming" age and a "going" age.

Analysis of the records showed that in a sprint of about half a mile, with the racers carrying 113 pounds, old horses can run as fast as young horses.

For many years race horses have been handicapped by placing weight on their backs; the better a horse is considered, the more weight he is made to carry in a race. Dr. Laughlin agrees with all practical horsemen that putting weight on a horse will slow down his speed. But he doesn't agree with them that taking weight off a horse will make him run faster. Scientific study of the racing records has proved that there is a limit to increasing speed by decreasing weight carried. This may be caused by the fact that a race horse, like a sailing yacht, needs a certain amount of ballast, or by the fact that small jockeys usually aren't so good race riders as are larger boys.

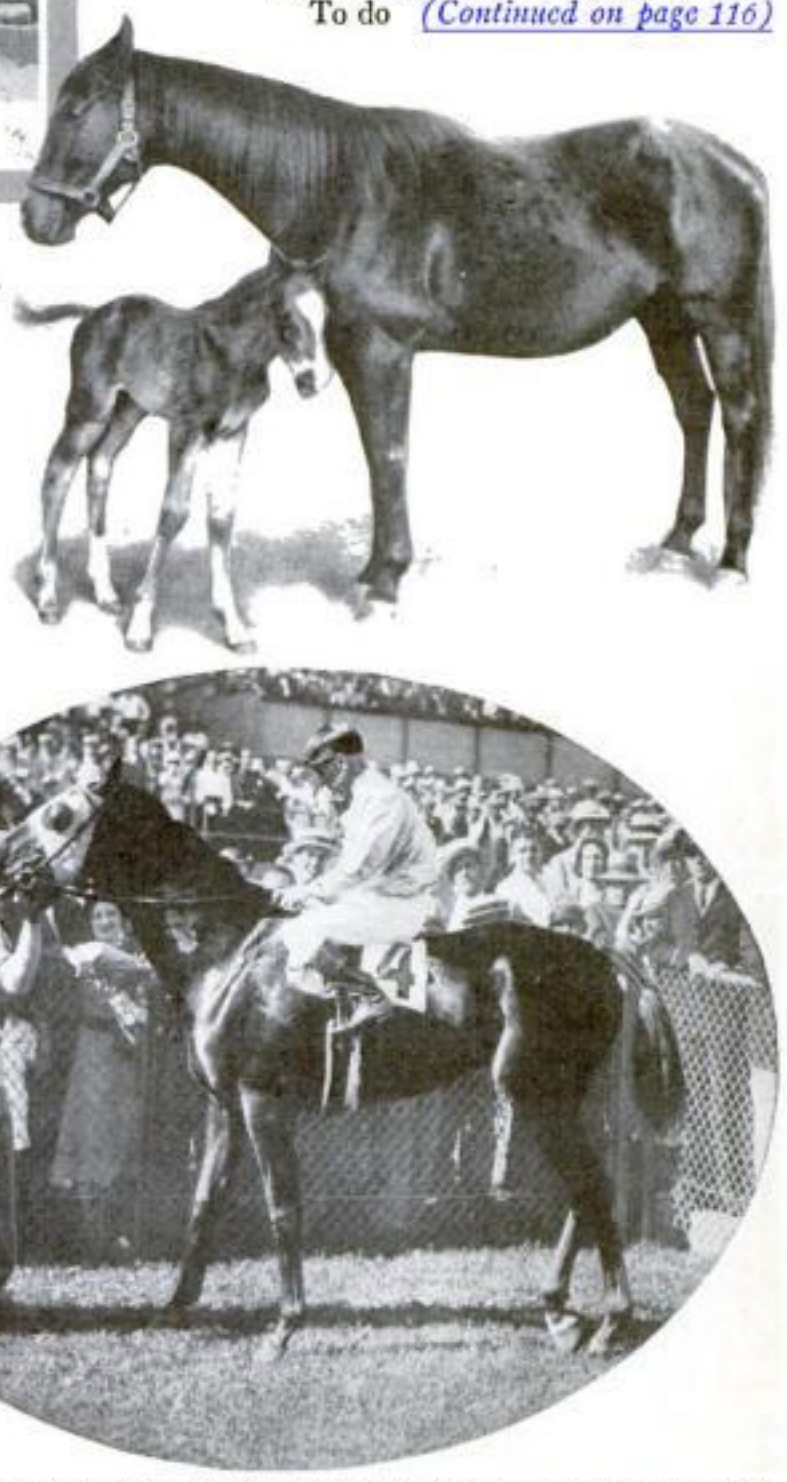
Taking into account all of these factors and how they interact on one another, the Standard Horse was evolved by a series of complicated mathematical calculations. If he is three and one quarter years old, and he carries 134 pounds, the Standard Horse will run a six-furlong race at the rate of twelve seconds per furlong. If he is asked to run seven furlongs at that rate of speed per furlong, he will have thirteen and one-half pounds taken off his back, and will carry only 120½ pounds. He will carry that same weight if, when he is seven years old, he runs a six-furlong race at the twelve-seconds-per-furlong speed. He's a sportsmanlike animal, that always meets his challengers on even terms.

Having put together this ghost horse to serve as a universal standard for measuring racing capacity, Dr. Laughlin and his assistants tackled the long job of finding out just how real thoroughbreds compare with the ideal race horse they had developed.

To do *(Continued on page 116)*

GREATEST OF THEM ALL

Above, Man o' War, credited with being world's greatest race horse. He beat the Standard Horse nine times out of twenty-one starts. Right, newborn colt whose Futurity Index is based on the records of sire and dam and indicates what speed can be expected of him



Equipoise, holder of record for the mile, was often beaten by the phantom horse

Before the races, jockeys are weighed to determine how much additional weight must be carried by the horses they ride

Railway Mountain Tunnel Brings Water to City

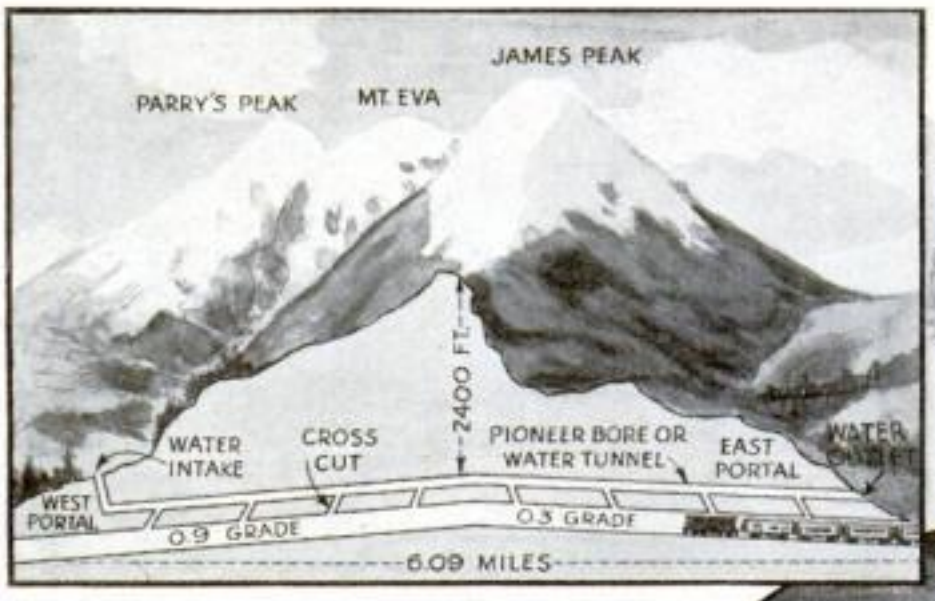


Illustration shows how pioneer tunnel was used in constructing Moffat Tunnel. In the future it will carry water across the Continental Divide

Retaining dam on Pacific side of Divide that will be used in turning water into new tunnel

Drilling crew at work in the six-mile tunnel that will carry water through mountain to Denver

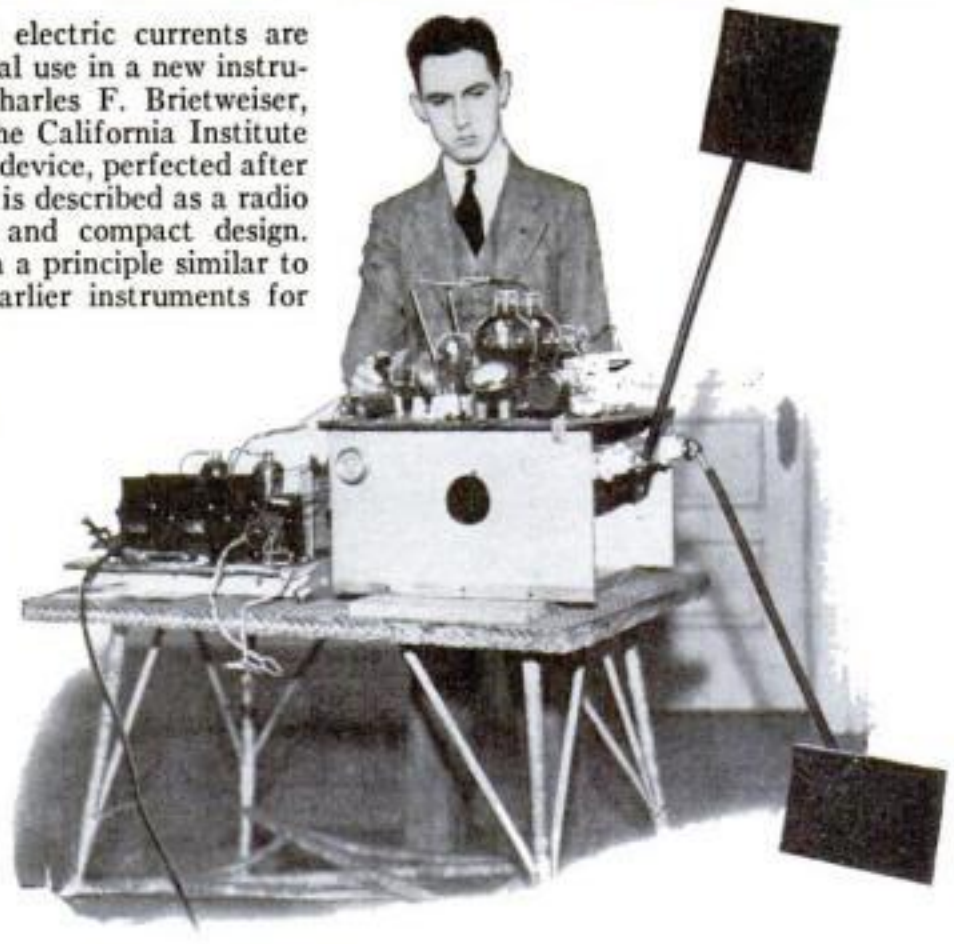
WORKMEN are applying the finishing touches, as this issue goes to press, to a six-mile-long tunnel that pierces the heart of a mountain to bring water to Denver, Colo. The supply will benefit both city dwellers and ranchers in a region where the annual rainfall is less than fourteen inches, and where drinking water, as well as water for irrigation, is now brought through canals for more than 100 miles. Behind the achievement lies a romantic story of an aqueduct that seemed impossible to build, until a quirk of fate handed it over virtually ready-made. Tapping snow-fed rivers high on the opposite slope of the continental divide has long been a dream of Denver water engineers, but lofty James Peak towered in the way, a seemingly insuperable obstacle, until the boring of the Moffat Tunnel. To explore the way for this now-completed railway route, men hewed and blasted a smaller pioneer shaft of eight-foot diameter straight through the mountain along a parallel course. Engineers were quick to see that this exploring tunnel, once it had served its purpose, would provide a means of bringing water across the divide. Lined with concrete, it would make an ideal aqueduct. Last January, citizens of Denver voted the necessary funds, and the work is now being rushed to completion. Dams on the Pacific side of the slope will impound the water of the Fraser River and other streams and send it down deep shafts into the water tunnel, gathering enough pressure to rush onward over the hump at the center of the tunnel and emerge at the eastern portal. A natural ravine will lead the long-sought water to a reservoir near Denver. Surplus water, brought through the mountain, will be stored in the irrigation reservoirs where it will be held for the use of the dry farmers in that region. By ending threats of a water famine, the tunnel will repay estimated cost of $3,500,000.

USE WAX ON PLANES TO INCREASE THEIR SPEED

JUST as a housewife waxes her floors, aviation mechanics apply a periodical coat of wax to the wings and fuselage of the three-mile-a-minute planes on the coast-to-coast route of the United Air Lines, polishing it to a smooth finish with an electric machine as shown above. The odd treatment increases the planes' speed.

NEW RADIO KNIFE SPEEDS OPERATIONS

HIGH-FREQUENCY electric currents are harnessed for medical use in a new instrument devised by Charles F. Brietweiser, research fellow at the California Institute of Technology. The device, perfected after months of research, is described as a radio knife of advanced and compact design. While it operates on a principle similar to that employed in earlier instruments for making clean and bloodless surgical cuts electrically, it is declared to make possible many types of operations not attempted with the apparatus hitherto available.



New-type radio knife for surgeons exhibited by its inventor, Charles F. Brietweiser of California Institute of Technology

ALUMINUM FLOOR EASES BURDEN ON OLD BRIDGE

When a fifty-one-year-old highway and railway bridge at Pittsburgh, Pa., proved overloaded by modern traffic, city engineers had the alternative of finding a way to lighten the load or building a new bridge at a cost of nearly $2.000,000. They solved the problem by ripping out the old steel flooring and replacing it with a new floor of aluminum-alloy girders and plates, thus saving 750 tons' dead weight and creating the world's first aluminized bridge. The photograph shows one of the workers holding a pair of aluminum members that if made of steel would weigh three times as much.

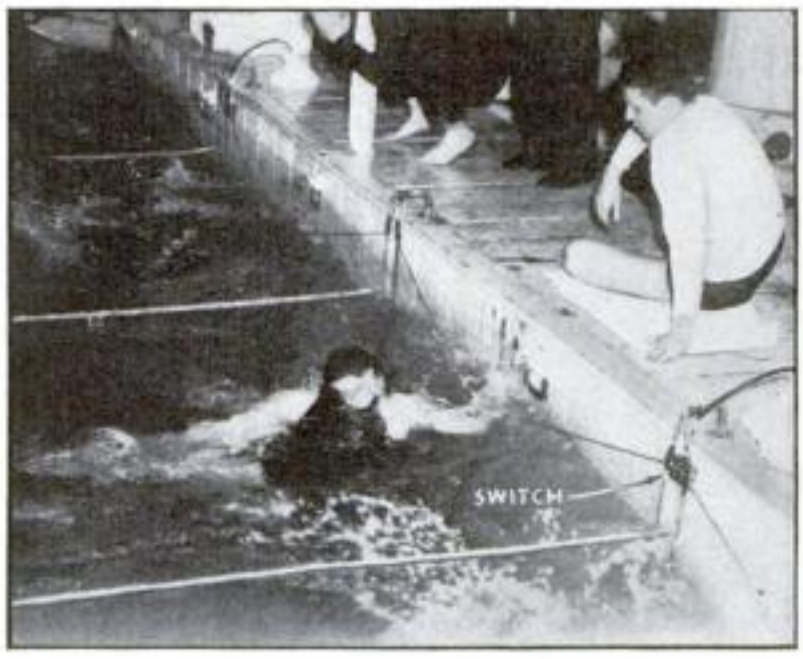
MECHANICAL LEGS CARRY MAN TO WORK

Because walking to work tired him, a Los Angeles, Calif., inventor constructed from an old bicycle, wooden legs, and old shoes, the mechanical legs seen at right. Perched astride this contrivance, he is able to walk sitting down by turning a pair of foot pedals, which operate the artificial feet through an ingenious crank mechanism. The inventor says the knack of balancing the apparatus is easily acquired.

Mechanical legs, made at home, are operated by bicycle pedals

ELECTRIC TIMER CLOCKS SWIMMING RACE

An electric timer that clocks swimming races in tenths of a second has been tried out successfully at Columbia University. A switch attached to the starter's gun sets a time clock going at the instant the cartridge explodes. When the swimmer, at the finish of the race, touches a wire grid that hangs in the water, the mechanical contact operates a second switch that stops the timing clock. The latter electric circuit is set in readiness from the main control board as the last lap begins. The apparatus also announces the winner.



Above, electric timer and the gun that starts it. Left, the device in use to time a match

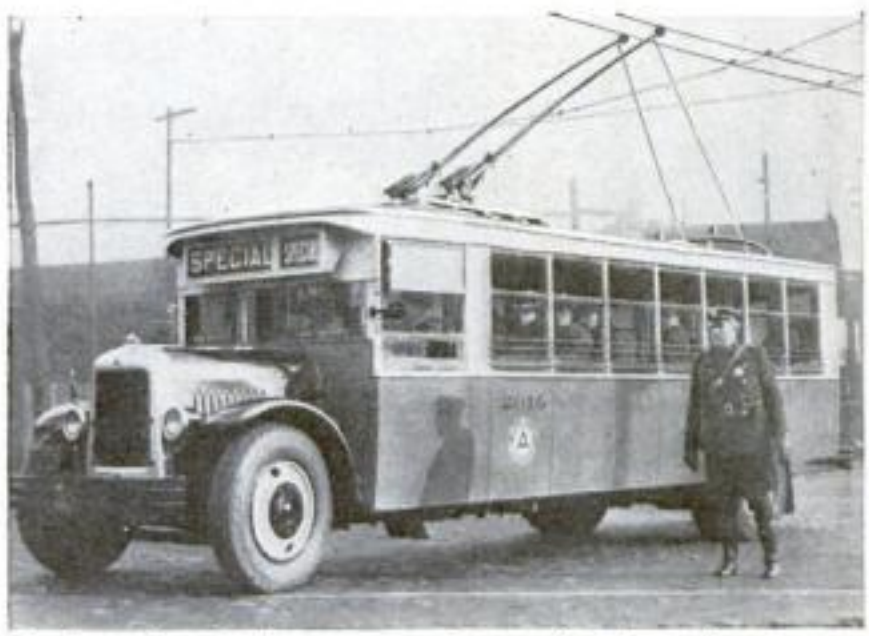
WATCHES TESTED BY JOLTING MACHINE

Railway watches are shaken in this device to test them

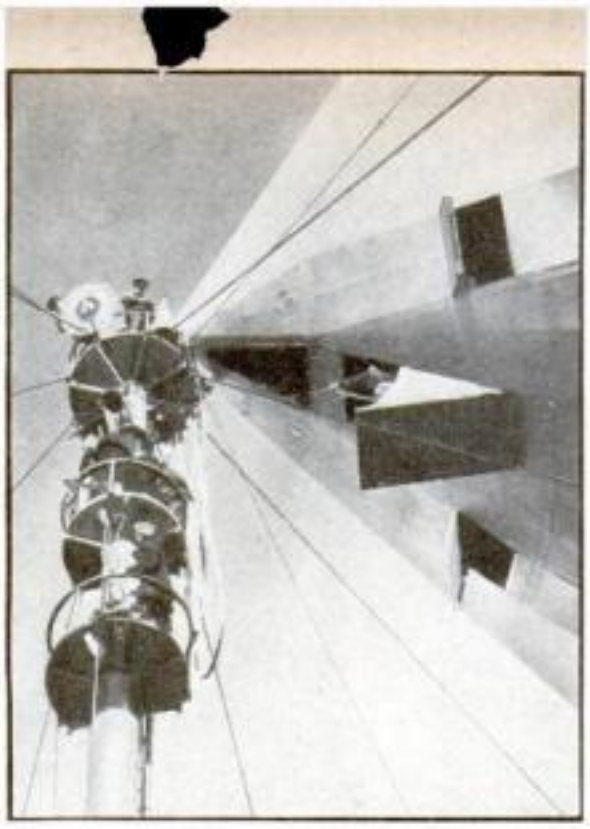
To discover if the watches used by railroad men will withstand the shocks to which they will be subjected in service, officials of one British railway have installed a shaking table to test them. Twelve watches at a time are placed in this device, which is run by an electric motor, and are subjected for fifteen minutes to constant jolting and jarring. Timepieces that are still running after this strenuous treatment are considered satisfactory for use. The device is also used to test small clocks and other instruments that are likely to become inaccurate through rough handling.

TROLLEY WIRE OR GASOLINE RUNS BUS

A hybrid thirty-passenger bus that operates on either its own or trolley-wire power has just been placed in operation at Weehawken, N. J., where a long grade has hitherto slowed service. Going uphill, the bus takes its power from overhead wires and speeds past other traffic at thirty miles an hour. At the top, the driver lowers the poles, and the bus then uses its own gasoline motor.



Big bus equipped so it can get power from trolley wire or its gas motor



CAMERA SNAPS AIRSHIP AT INSTANT OF TAKE-OFF

SNAPPED at its mooring mast during a recent visit to the California coast, the unusual view of the giant airship *Macon* reproduced above shows the last-minute preparations to cast off. The gangway has been removed and the trapdoor in the ship's hull is about to be closed, while men stand by to assist in the maneuver. The clocklike dial at the top of the tower is used to signal instructions to the ground crew during the take-off.

COD-LIVER OIL MADE TO TASTE LIKE CANDY

MAKING cod-liver oil taste like candy is the accomplishment of Canadian Government Fisheries research workers. The oil is mixed with cocoa to form a chocolate-coated confection in which it is said to be impossible to detect its taste or odor, although all the health-giving qualities are retained.

DRUMS BEAT SIGNAL CODES

NATIVES of the Congo, Africa, need no telegraph system to signal the news from one village to another, for drums provide them with an adequate means of communication. Explorers and scientists have made careful study of the codes used in tapping messages, and have found them as highly developed as any in use among civilized people. Congo drums, like the one shown in the photograph, hollowed from half a log, have a resonant tone that carries for miles.

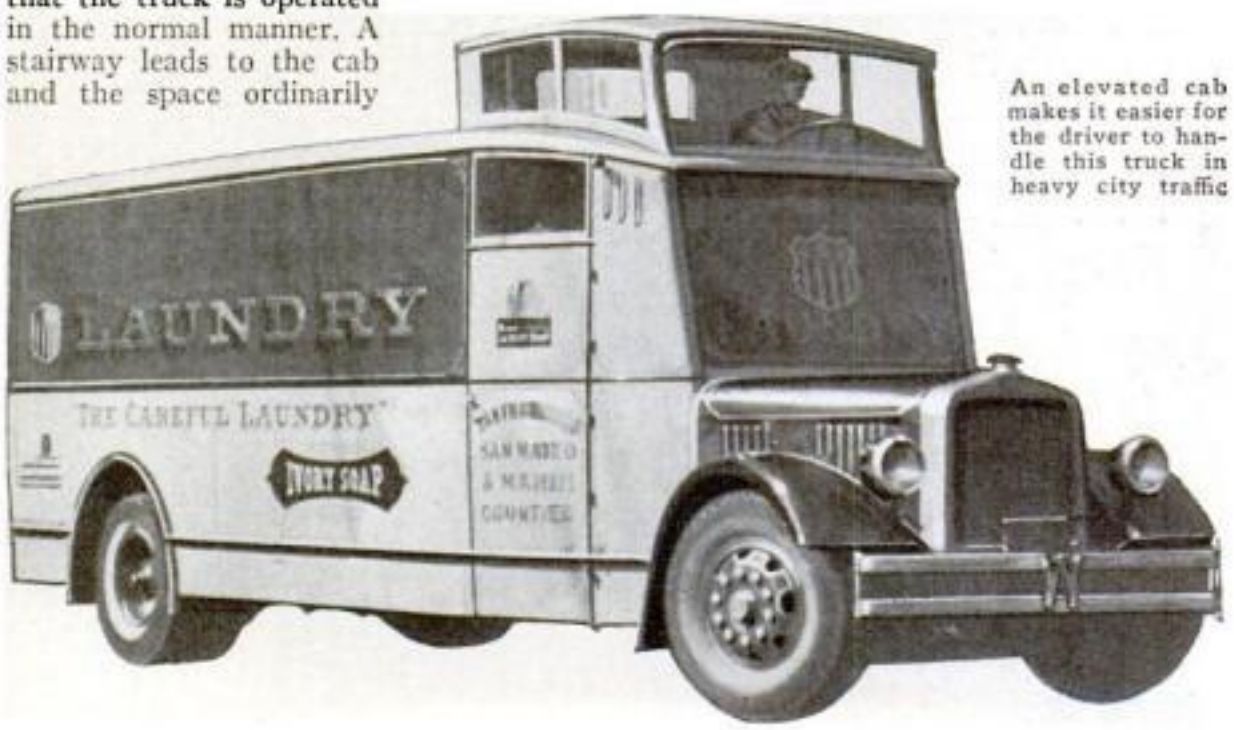
Code signals that can be heard for miles resound from this log drum used in the jungles of Africa

NEW PLANE MOTORS ARE IN SECTIONS

AVIATION engines of a new sectional style, designed with one, two, or four banks of cylinders, have been developed by a Berkeley, Calif., firm. The cylinders are arranged in opposed pairs and operate in such a way that the hollow propeller shaft rotates at half the engine crankshaft speed, without the use of cam shaft gears. Propellers of adjustable pitch, controlled by the pilot while in flight, have been designed especially for use with the new motors. The picture at left shows the first test of one of the new motors.

DRIVER HAS HIGH SEAT IN BIG TRUCK

BECAUSE of the difficulty in handling in traffic the large truck shown below, the driver's compartment was elevated to give greater vision. Controls were extended so that the truck is operated in the normal manner. A stairway leads to the cab and the space ordinarily occupied by the driver provides additional storage space. The door at the front allows easy access to the load. Rear vision is also wholly unrestricted.



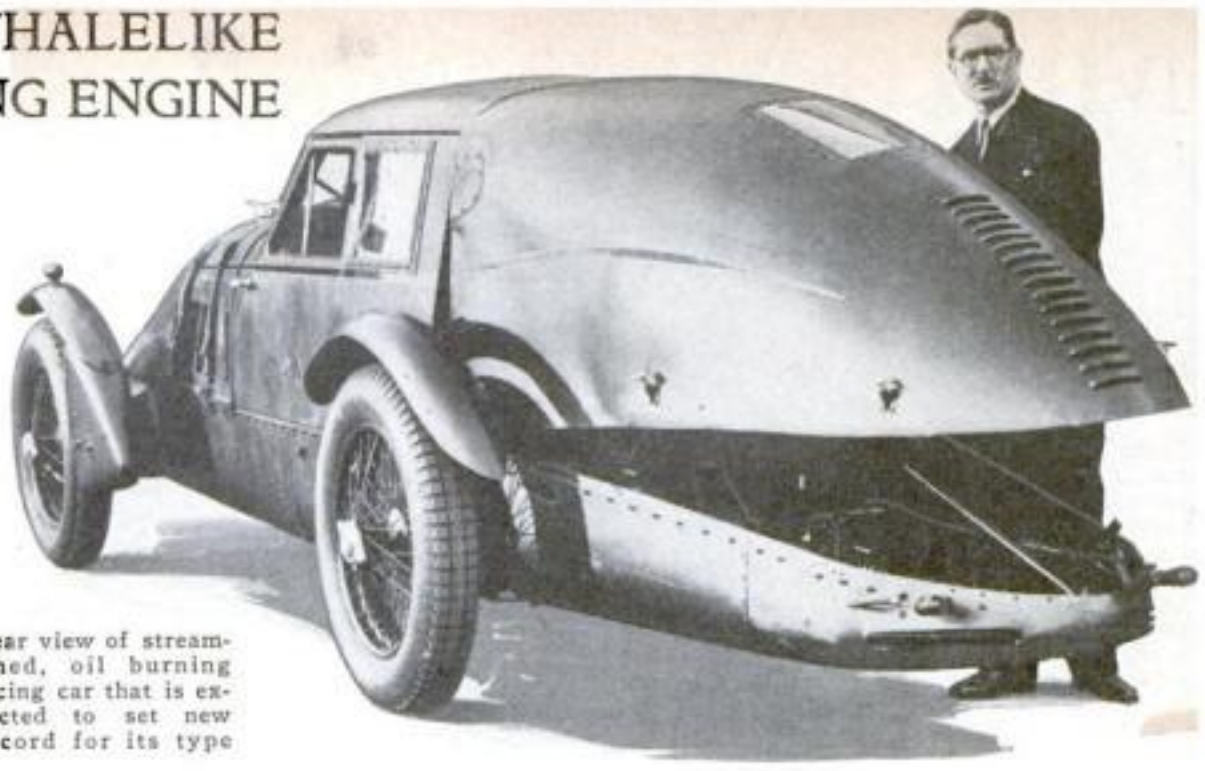
An elevated cab makes it easier for the driver to handle this truck in heavy city traffic

RAYS NOW FEVER TEST

FOLLOWING the invention of devices that detect the infra-red rays or radiant heat radiated by the human skin, their use is proposed by Dr. Jean Saidman, French physician, as a substitute for a clinical thermometer in taking a patient's temperature. One of the recently developed heat-detecting devices is shown above registering warmth of a girl's face.

RACING CAR, WITH WHALELIKE JAWS, HAS OIL-BURNING ENGINE

USING oil instead of gasoline as fuel, a strange racing car, designed by George Eyston, noted British driver, has already attained speeds of more than 100 miles an hour. Its designer expects to exceed this mark in trials scheduled for the near future. Streamlined and provided with a folding rear deck that, when open, suggests the jaws of a whale, the car is believed to be the fastest of its kind in the world. A 130-horsepower fuel-oil engine of new design provides the power.



Rear view of streamlined, oil burning racing car that is expected to set new record for its type

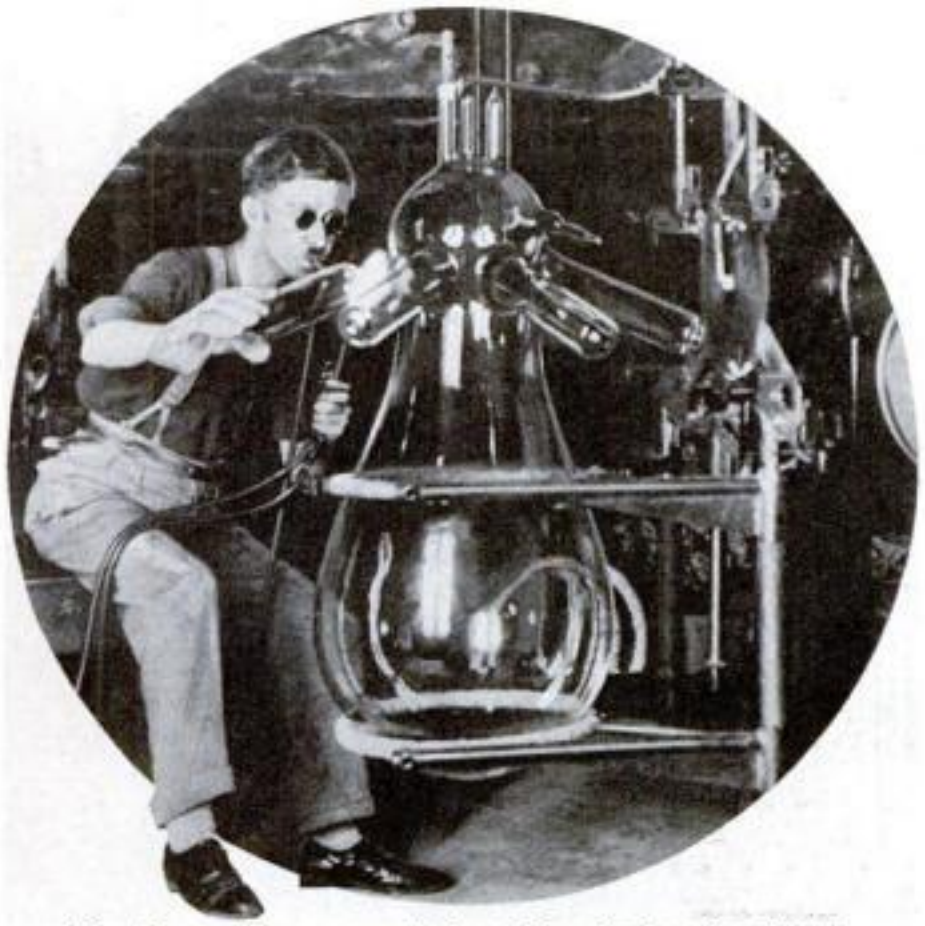
BIGGEST GOLD NUGGET FOUND IN AUSTRALIA

ALL the gold nuggets that have thrilled lucky prospectors are insignificant beside a giant of which a model is on display at the Smithsonian Institution, at Washington, D. C. Largest ever found, the original weighs 2,195 ounces and is worth a small fortune. It was discovered in Australia in 1858. Photograph shows nugget and twenty-dollar gold piece.

ELEVEN MEN CARRY SEISMOGRAPH WIRE

PHILADELPHIANS witnessed a strange procession the other day when a long copper wire was moved from a factory to the Franklin Institute Museum, where it will be installed in a giant seismograph. So sensitive that it could not be allowed to sag, the wire had to be carried by eleven men, walking in single file. It will support a 1,500-pound ball and help recordearthquakes.

GIANT GLASS TUBE HAS OCTOPUS ARMS



Glass blower fitting an arm to the cooling chamber of a gigantic rectifier tube which will be used in the operation of subway

SOME of the elaborate vacuum tubes used in modern electrical industry are veritable triumphs of the glass blower's skill. The photograph at left shows a British workman completing a giant tube in the shape of an octopus for installation in one of London's largest power stations. The strange device is a rectifier tube, and will serve the purpose of transforming alternating current into direct current for the operation of one of the city's subways. At the moment the picture was snapped, the mechanic was fitting an arm to the tube.

GAS MASK DESIGNED FOR WORKERS ON AIRSHIPS

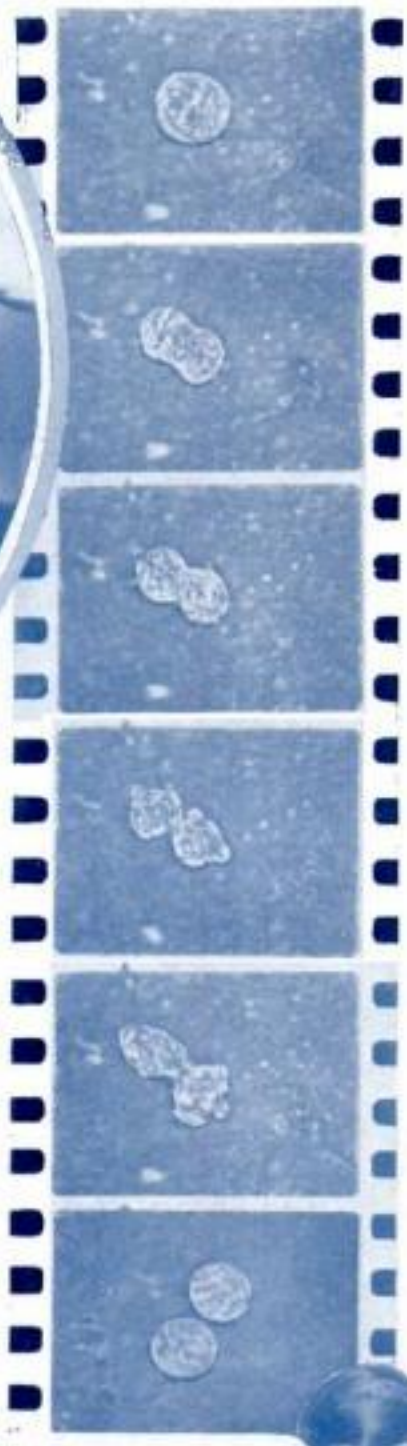
SO WORKMEN may enter the gas-filled hulls of airships, Army experts have designed a special type of breathing mask for them. Shown above, it carries a pair of trailing tubes, and air is pumped through one of these to the worker. The other serves as an exhaust.

Micro-Movies Show Life Secrets

GROWTH OF CELL RECORDED IN REMARKABLE PICTURES

STUDY OF LIVE CANCER CELLS

From white mice, carefully bred and reared, comes the tissue that is used in studying the growth of cancer cells. In this way scientists hope eventually to discover a cure for the disease



Film above shows the various steps in the process of cell division

SEEKING a cure for diseases that until now have baffled medical science, experts in laboratories here and abroad are pressing into service the latest of microscopic aids. Apparatus that would arouse the envy of amateur and professional microscopists alike has been assembled for this purpose by Dr. N. Hoefer, world-famous specialist in skin diseases, at the Berlin Hospital for Skin Disease and Research. The unusual series of photographs reproduced on this and the following page show what goes on behind the scenes in this laboratory, where some of the most brilliant pioneering work of the present day is being carried out. An elaborate motion-picture camera of special design records indelibly, in standard or slow-motion movies, the drama that takes place beneath the lens of the microscope. Meanwhile the latter is kept in a special incubator, whose temperature is carefully regulated so that germs or other cells may develop exactly as if they were in their normal environment. In this manner Dr. Hoefer has obtained films that have aroused exceptional interest in the scientific world. Cells of animal tissue, corpuscles of the blood, and bacteria are among the actors that perform for his movies, while one of his series of pictures shows, with unprecedented clearness, the spread of cancer cells.

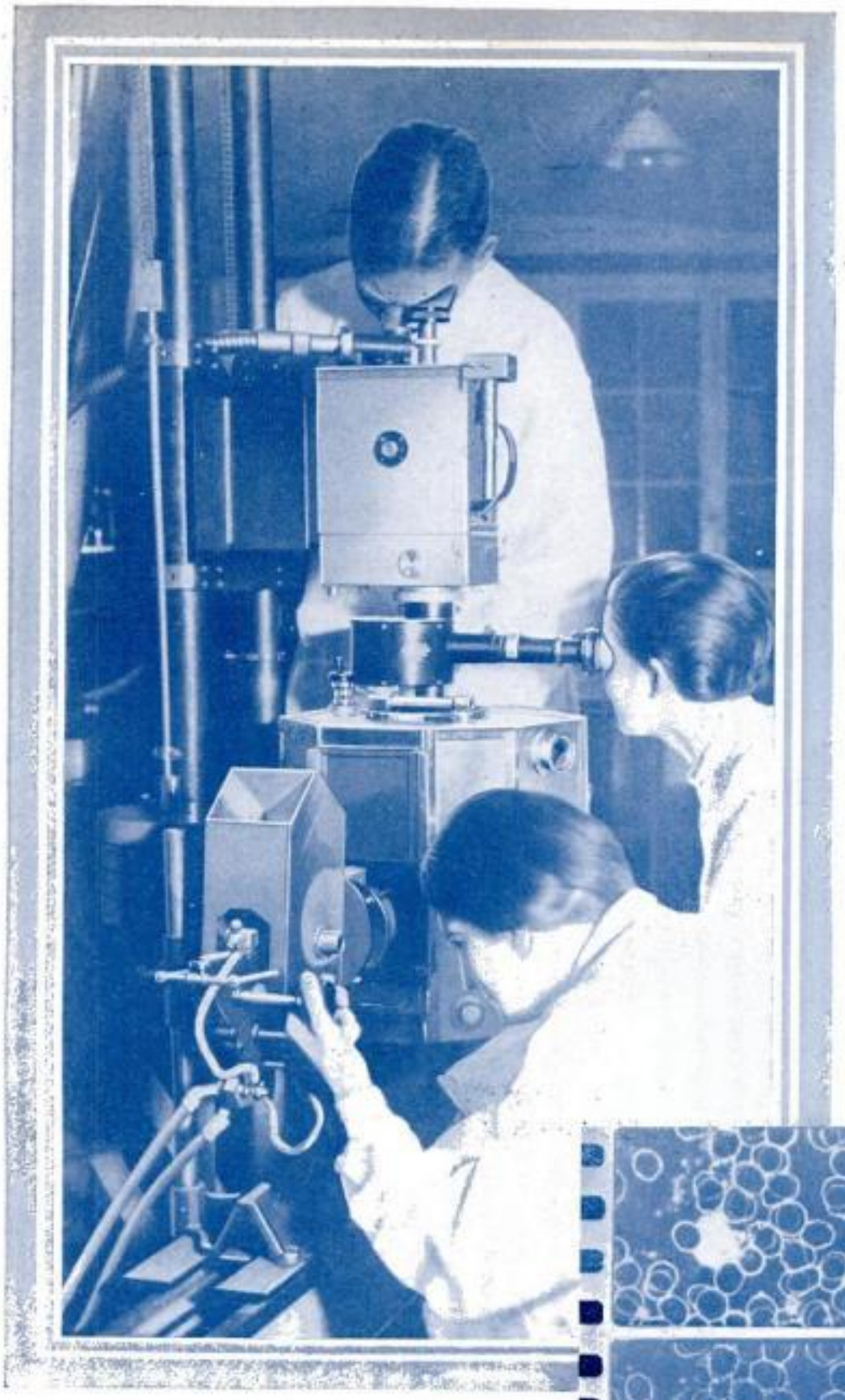
PREPARING THE TISSUE

Above, using a powerful magnifying lens, a section of tissue as thin as gossamer is sliced off the prepared material. During this process, the specimen is kept beneath a pane of glass to shield it from the breath of the operator

WHIRLING OUT THE PLASMA

In the cups seen in the center of the machine shown above, drops of blood are placed. The cups are then revolved at high speed and centrifugal action separates out the watery plasma used in tests, the corpuscles sinking to the bottom

New Way of Photographing Tiny Living Organisms, with a Powerful Lens, Aids the Thrilling Search for Cures of Mysterious Diseases



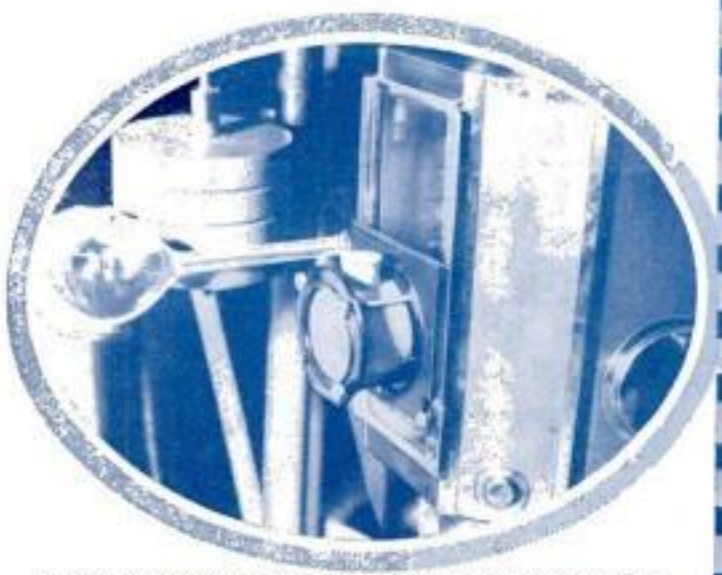
READY TO MAKE A MICRO-MOVIE

In the center of the picture is the incubator in which the microscope and slide bearing the cell to be filmed are placed. At its left, arc lamp that illuminates the specimen. The picture is taken through a window in top of incubator. At right, a film of white corpuscles moving through red ones

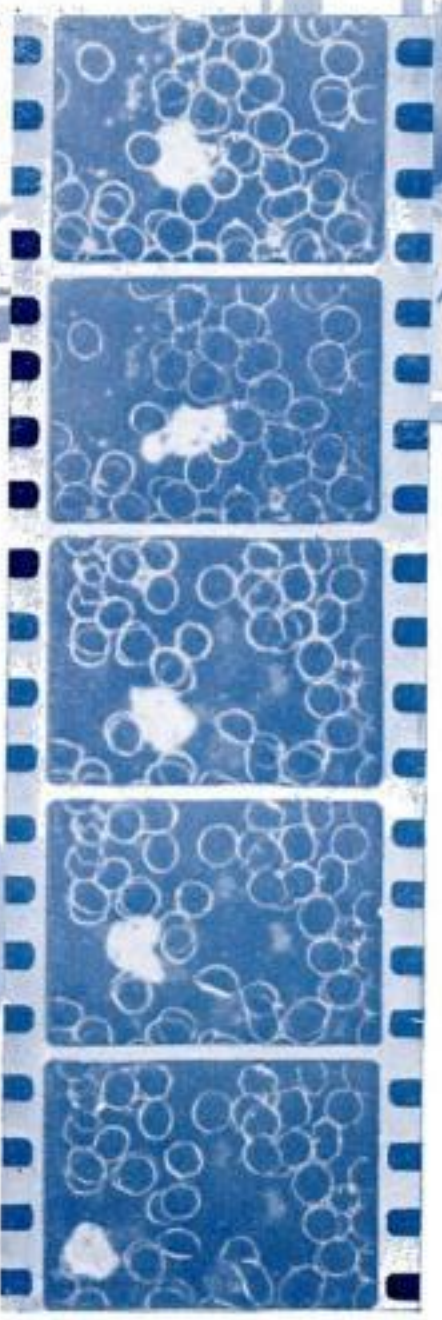
BIRTH OF NEW CELLS

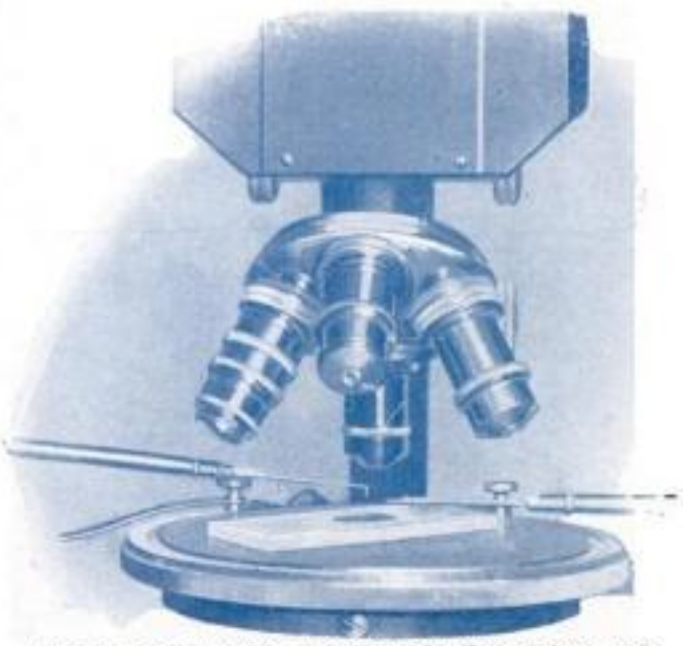
Photomicrograph, left, gives remarkable view of cells in act of dividing. All details are clearly shown, even the tiny connecting filament being visible. This is said to be one of the clearest pictures of this process that has ever been made by scientists

The microscope and the specimen to be photographed are being placed in the incubator. The instrument can be focused from the outside and three persons at once can observe the subject that is being filmed



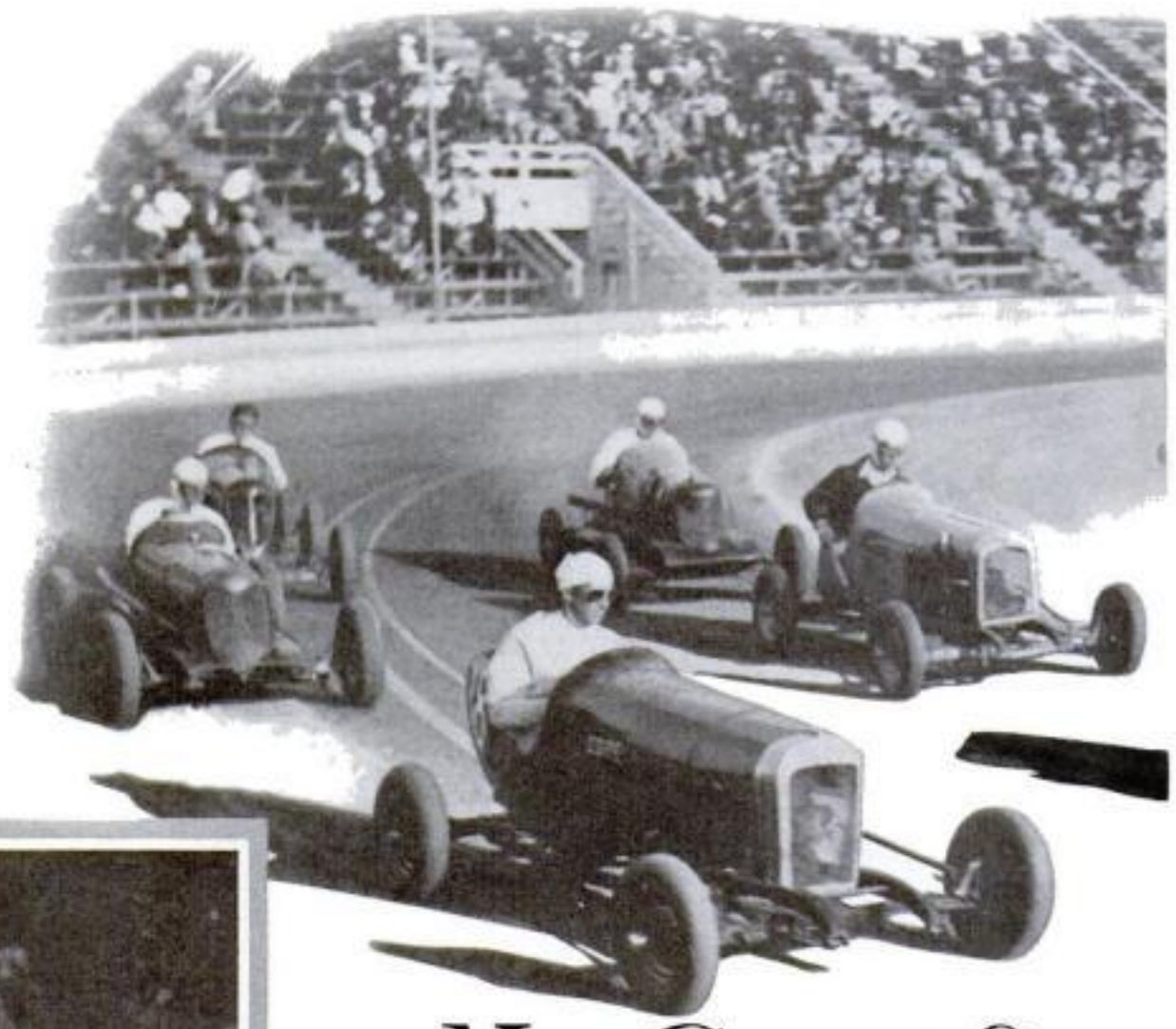
LIGHT COOLED BY WATER. To prevent the heat of the arc lamp from injuring the specimen, the receptacle seen above is kept filled with water. It is between the light and the incubator





Glass needles with unbelievably fine points are used in this micro-manipulator to separate out the individual cells beneath the microscope lens

Racing Midget Autos

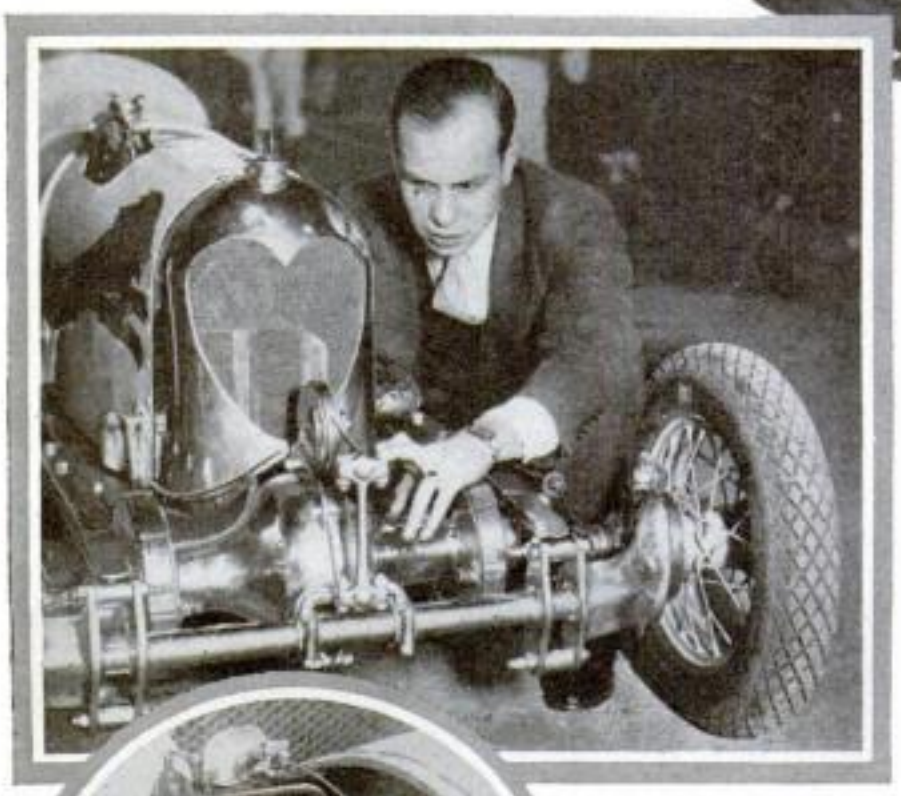


MIDGET racing cars, whose drivers sit only four inches from the ground, slither and skid around nine miniature California racing tracks to give the public their newest speed chills and thrills.

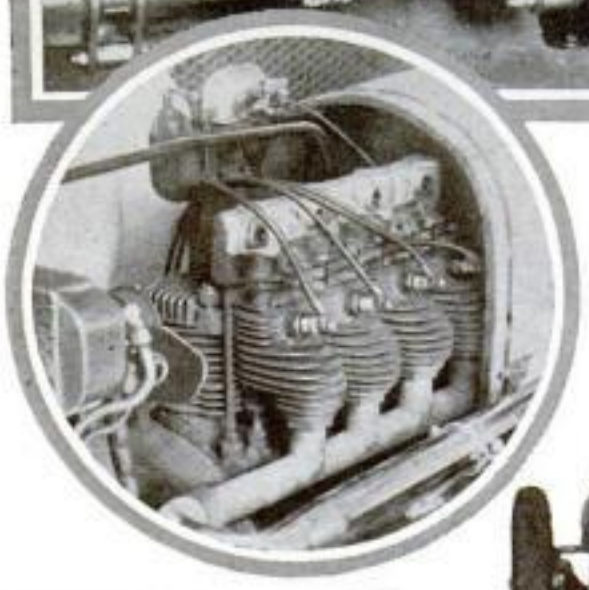
Daring drivers race the tiny speedsters over flat dirt tracks only a fifth of a mile long. Yet on a 300-foot straightaway they attain speeds approaching sixty miles an hour before skidding around flat turns as their wheels churn the earth and the junk-pile engines roar their songs of power.

Only during the last year has midget racing been presented to the public. Last August there were eleven of these tiny cars in existence in the West, yet now fifty-six drivers dare death on the abbreviated tracks.

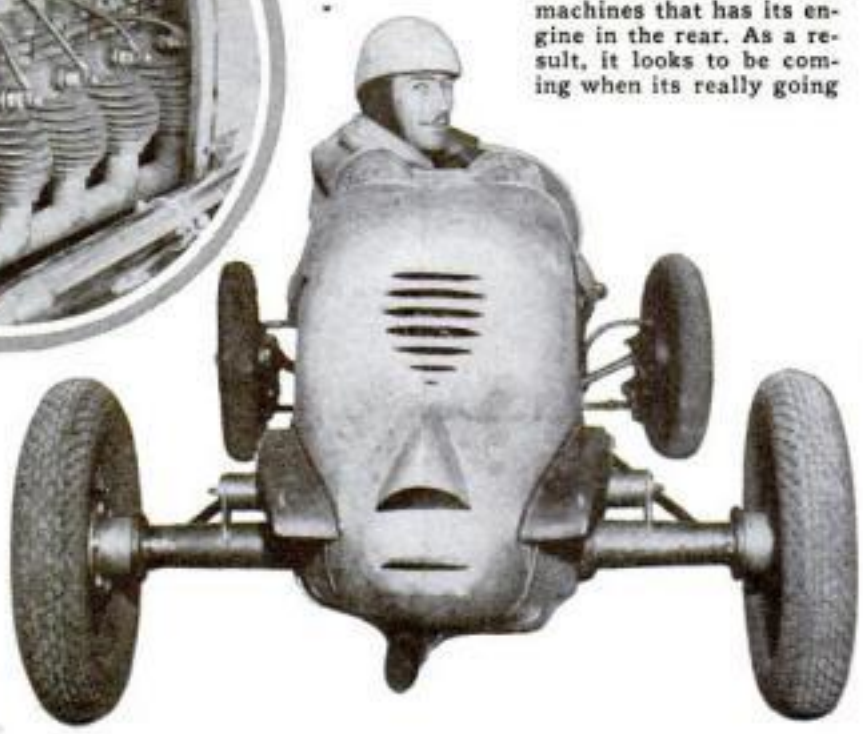
There are no elaborate track layouts, no banked curves, no well-equipped pits



Left, one of the front-drive racing cars under inspection. Note the excellent workmanship of this homemade car. This kind of finish is typical of most of these baby autos



Four-cylinder motorcycle engines, set in place like an auto's engine, are used in many of the tiny home-built racers



Below, one of the little machines that has its engine in the rear. As a result, it looks to be coming when its really going

A New Game of Speed,

to supply instant service. Races start and end too quickly to require these luxuries of big-car racing. Just a flat surface, not too smooth; board fences to head off the cars on the curves; a bunch of cars from back-yard workshops and garages, with their dare-devil drivers—and an ambulance. These constitute the full equipment for racing dwarf automobiles.

Discarded motor-cycle engines, outboard motors, and engines from ancient cars provide the power for these sensational racers.

As many as thirty cars participate during a single evening, from single-lap qualifying bursts of speed to the thirty-lap main event. Eight cars take part in the big race of each meeting with terrific flights of speed on the short straightaways, skidding together into the turns only to straighten out and come roaring past the stands.

The whole show takes place almost in the laps of the audience. Never farther than 300 feet from any onlooker, the cars rush by within fifteen feet of those sitting in the front row.

All sorts of cars with all types of controls, from three-speeds forward to single speed with a hand-operated clutch; airplane wheels and wheels cut down from small passenger automobiles; four-wheel brakes; thermo-syphon cooling systems; front-wheel drives—everything a bunch of enthusiasts can bring together rolls by the stands in a single evening.

Bill Brenneman, a ruddy and husky mechanic, leads the pack and so boasts the coveted No. 1 on his car at the end of the first season of racing. Brenneman built one of the few front wheel drive midgets. His good judgment is borne out by his present standing. He has won more races than any other driver.

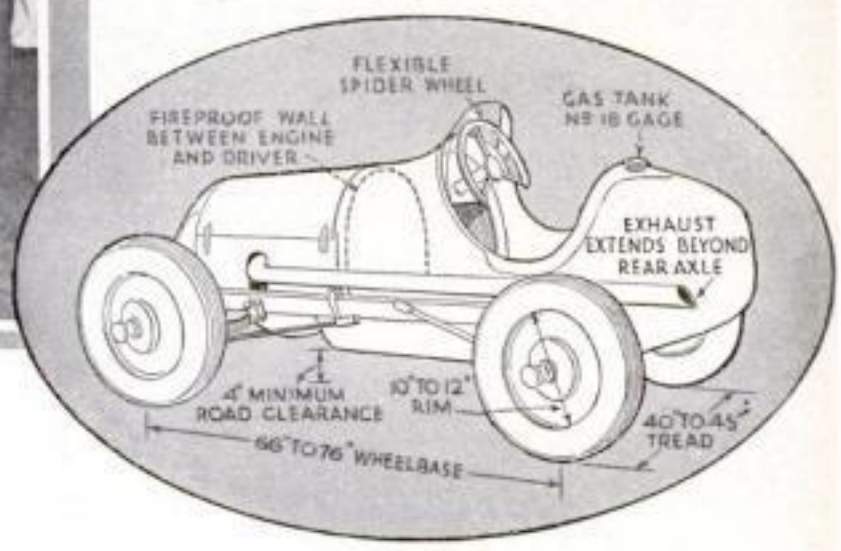
In nearly every race, cars skid into the fence and crash but usually drivers are not hurt

On a dirt track, only a fifth of a mile in length, the racers hit the curves at 50 miles an hour

Thrills . . . and Spills!

By
ANDREW R. BOONE

Illustration below shows the main specifications that must be met by each car entered in a race. The fire-proof wall protects the driver



His speedster is a duplicate in miniature of the famous Miller specials, seen on all tracks where large cars race. He uses a discarded four-cylinder motor-cycle engine with a single speed forward, no reverse and no rear axle. A hand clutch, operated by a lever outside the car, disengages the engine. A pedal operates four-wheel brakes. Should Brenneman become involved in a serious crash the car, if upright, will clear the ground after all wheels have been torn away, for a tubular brake spindle with safeties will continue to hold the car up. This daring driver has found what he considers the most expert method of continuing at high speed, even while skidding on the sharp turns.

"I get probably sixty miles an hour down the straightaway," he told me. "As I hit the turn I ease off on the throttle, skid sideways, then step on her again. The front drive keeps pulling me toward the center of the track, whereas a rear drive tends to cause the back wheels to break traction. That causes many of the accidents.

"Always I try to get as close as possible to a spin on the turns without actually spinning. An experienced driver can 'feel' the right moment to straighten out and give her the gun again. Spins are dangerous. If I spin, the other guys pass me; and if I turn over, they run into me. That's not so funny."

The drivers lean inside as they roar around the curves, watching the inside front wheel. A steady shower of dirt beats them in the face. In fact, the sand and dirt fly back with such power that they blast paint and chronium finish off the metal, requiring complete refinishing every month.

"Happy" Woodman, who stands second in the association's list of victories, is another of the veterans. Recently he took his front-drive car out from Los Angeles to Muroc Dry Lake, whose hard sun-baked bed gave him fine opportunity for a speed test. The mechanical clockers recorded 110 miles an hour as he sped over a measured mile. Notches cut across the rough tread of his front tires help provide traction, especially when pulling out from a near-spin.

Woodman attains his great speed with a home-built four-cylinder, eight-valve, rocker arm, water-cooled, block in head mounted on a motor-cycle engine base, which turns up 4,000 revolutions a minute at fifty-five miles an hour.

He, too, has found the trick of fast driving.

"I feel the tail giving and know just how far to slide before straightening up and going across the curve," he explained.

For the first time there appears on a racing track a car with the engine mounted in the rear. Terry Curley drives this 700-pound novelty. He sits barely four inches from the ground, midway between front and rear axles. Though his car boasts no springs, he hurtles over the rough earth in comparative comfort as the car rocks up and down. The body rests on four rubber pads.

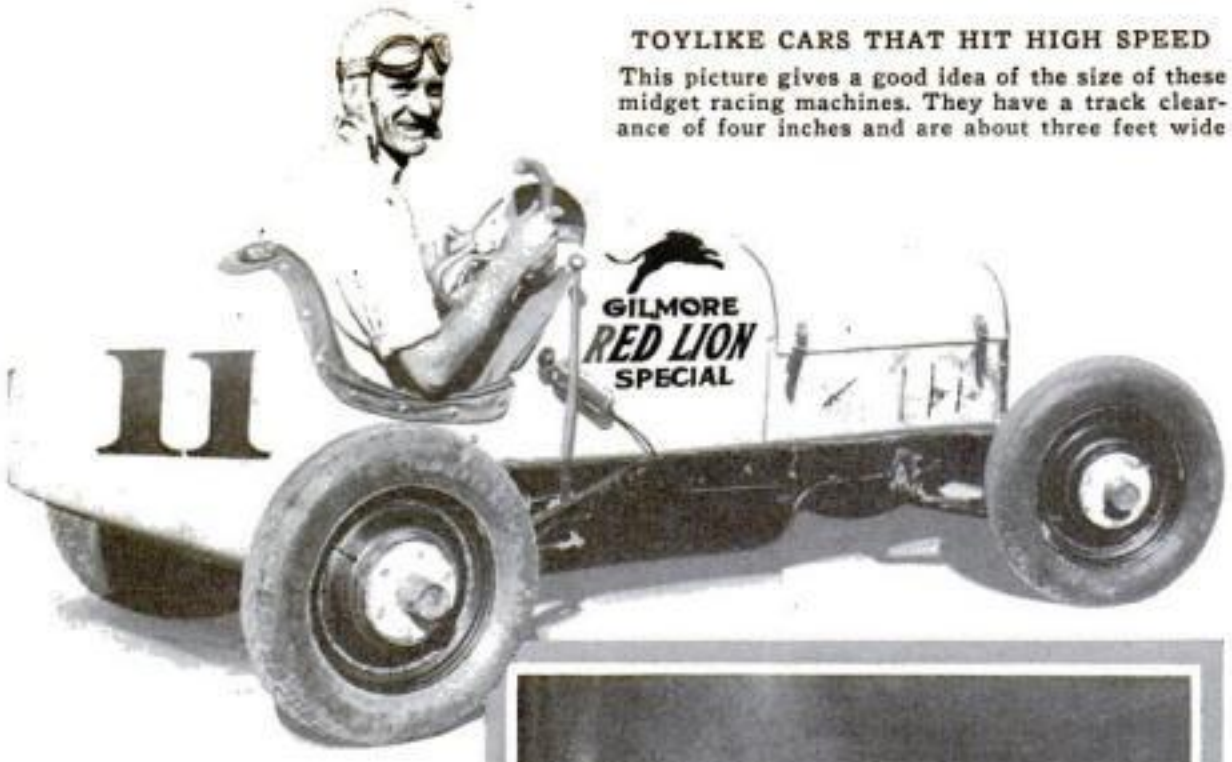
Four louvers cut in the cowling immediately behind his back carry air to the fins of his two-cylinder motor-cycle engine.

After breaking a finger when he plunged through a fence at Tracy last summer, Leo Faulkner missed eight race meetings—yet his 1925 Saxon engine, rebuilt many times, pulled him into third place. Faulkner is a veteran of big-car racing, but he finds bumping over the dirt at fifty miles an hour far more exciting than skimming over the Indianapolis speedway nearly three times that fast.

Cars line up for a standing start. The two men standing behind the driver give the machine a push to help it make a quick get-away

TOYLIKE CARS THAT HIT HIGH SPEED

This picture gives a good idea of the size of these midget racing machines. They have a track clearance of four inches and are about three feet wide



The drivers hit the curves at high speed and skid around them, as the tracks in this illustration show

Faulkner has evolved his own novel method of maintaining high speed.

"Fact is," he explained, "every guy has a different way. Now take me. I go as far down the straightaway as I can with the throttle on, then I let up as I hit the turn. I cramp the wheels in, skid about forty feet, then turn on the gas again."

"Isn't there danger of turning over," I asked.

"Not unless I hit another car," he grinned.

This is sounder reasoning than you may think. The tiny cars lose little speed while skidding and so are able to keep away from those in close pursuit. Their center of gravity is so low and the wheels so strong there is little likelihood of capsizing unless they make contact with another racer.

There are exceptions, and tragic they are sometimes. Red Frick slithered around the south turn at Loyola the other night, rolled over, straightened out, and turned end over end. The ever-present ambulance carried him away with serious injuries and probable disfigurement as his reward for a few minutes of thrill.

The game draws both veteran pilots and youngsters just out of school. Bill Betteridge, nineteen years old, graduated from high school last year and now is one of the stars with a homemade car rivaling the best in beauty and workmanship. For nine months, Betteridge worked every spare hour to build his racer, doing all his own body and machine work.

He is one of the few to utilize an outboard motor, with a three-speed motorcycle gear box adapted to a chain drive. Even with track gear, he has pushed his little red speedster seventy-five miles an hour over a measured course. "With a few changes," he says, "she'll do 120." Betteridge spent $500 in building his car, and with it climbed up to seventh place during his first year of competition. And he's only a half-mile an hour behind the miniature track record of fifteen and nine-tenths seconds set recently.

The boys spill all over the place as they collide on the turns, spin in the abbreviated straightaways, and lose control while trying to straighten out following a particularly fast turn.

Although the tracks measure only one fifth of a mile, all the cars roll up to fifty-five miles an hour between turns.

I have sat in the stands watching these cars roar around the oval, wondering how the drivers possibly could escape collision and serious, if not fatal, injury as they swept around the sharp curves. The soft dirt covering the flat turns is not exactly conducive to good traction.

Nor do they escape collision. Speed Lockwood recently slipped around the north turn at Loyola, in Los Angeles, straightened out, gathered speed and, exactly in the middle of the straightaway in front of the grand stand, skidded. He spun like a top. Charlie Baker, driving No. 2, smacked into Lockwood's car, which hit the fence.

This incident turned Lockwood's speedster into a "fence crashing fool," as Lockwood expressed it, and during the next five races it ran through fences exactly five times.

When Terry Curley defied custom by placing his motor in the rear of his car, he found it necessary to construct a body to conform with the engine placement, and unless you look twice his car gives the impression of running backward. Recently when he stepped on the throttle too suddenly, the car spun and wound up in the infield, with Curly nonchalantly looking across the pits at the audience.

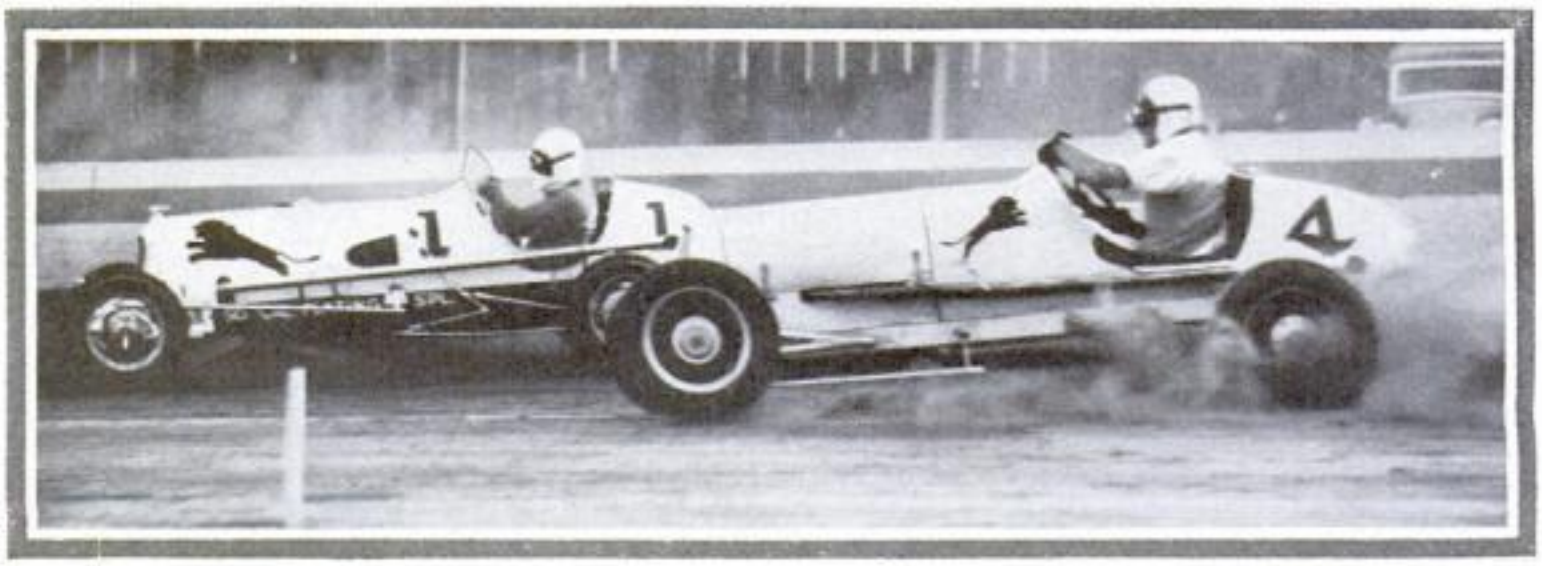
Few cars have turned over during several score races. In the first of these, Link lost a wheel. Woodman, following close behind, ran over the wheel and his car zoomed from the ground. In a series of bounces, it plunged into the grand stand, finally winding up with all four wheels in the air. Woodman crawled out with lips cut and nose battered. A week later he was racing again.

On the north turn at Long Beach, Leo Faulkner felt his steering gear break as he turned into the north curve. The car crossed the track, hit the fence, turned over and caught fire. From fifty miles an hour to a dead stop in a second, yet Faulkner escaped injury.

Dominic Distarce is the czar of the midget racers. While older promoters were sitting around thinking about reviving the sport, he went out among California enthusiasts, from San Diego to San Francisco, organized the Midget Auto Racing Asso- *(Continued on page 119)*

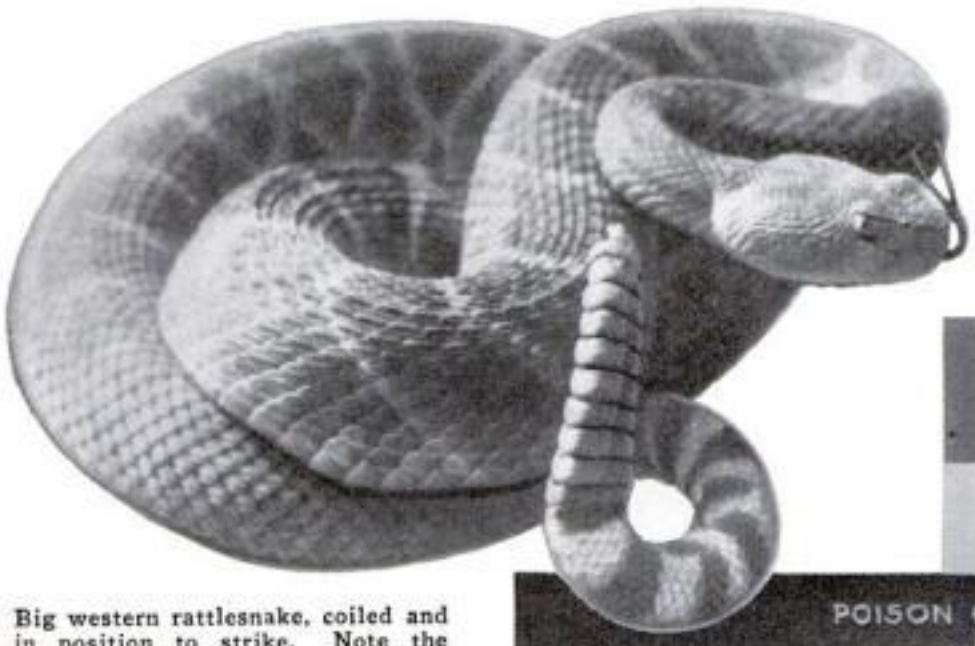
TAKING CURVE AT FAST CLIP

The racing cars crowd each other closely on the turns, as is seen in this picture. As they skid and then straighten out, they occasionally crash together, but they are so low and so strong that seldom do they overturn and serious accidents are rare

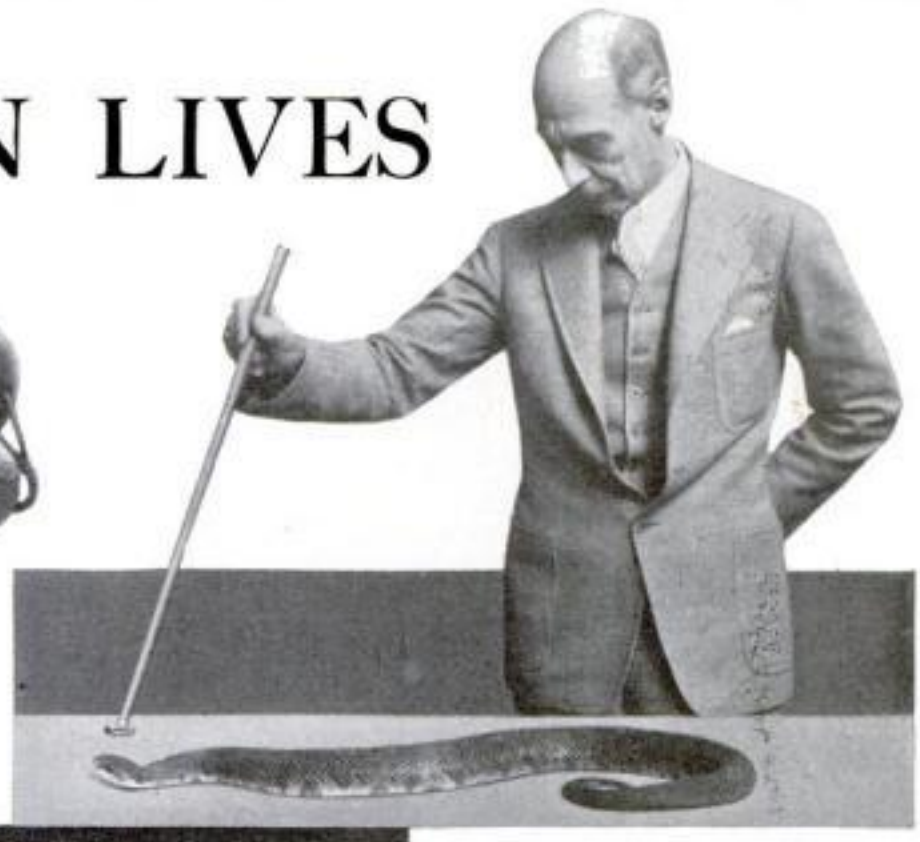


Deadly Snake Poison

SAVES HUMAN LIVES



Big western rattlesnake, coiled and in position to strike. Note the forked tongue that darts in and out



Raymond L. Ditmars, curator of mammals and reptiles at New York Zoological Park, ready to pin down head of water moccasin

By

GEORGE COOKE

FIGHTING disease with the poison of deadly snakes! That is an amazing new method of treatment reported in recent months by scientists.

The whitish venom of the cobra, the brilliant orange fluid of the water moccasin, and the poison that looks like melted butter and comes from the fangs of the Texas rattler form the strange fluids used in these efforts to relieve human suffering. Already encouraging results are reported in such varied and serious maladies as cancer, hemorrhage, tuberculosis, and epilepsy.

In New York City, Dr. Samuel M. Peck has been injecting diluted moccasin venom to prevent hemorrhage. Containing 3,000 parts salt water to one part of venom, his solution is injected hypodermically in doses of approximately a fifth of a teaspoonful at a time. The only reaction noticed by the patient is a black and blue spot which appears at the point where the injection is made. Some mysterious element in the venom increases the power of the blood to coagulate and stop bleeding.

Since 1930, Dr. Peck has treated 150 cases with excellent results. Even in hemophilia, where the blood of the victim seems lacking in some necessary element so he is likely to bleed to death from a slight injury or even a scratch, the venom treatment shows promise. Other snake poisons have been tried, but the venom of the water moccasin seems best suited for the work. The injections have no effect upon a normal person's circulation.

Illustration shows head of snake with position of poison gland and duct. The hollow fangs are attached to a hinged bone and lie flat in mouth

MILKING VENOM FROM A SNAKE

With the moccasin's head held down with a stick, upper left, Ditmars grasps it just back of the jaw bones. The distended fangs are then forced through heavy gauze covering the top of a glass into which the poison drains, as shown in the circle. Test tube holds venom from snake

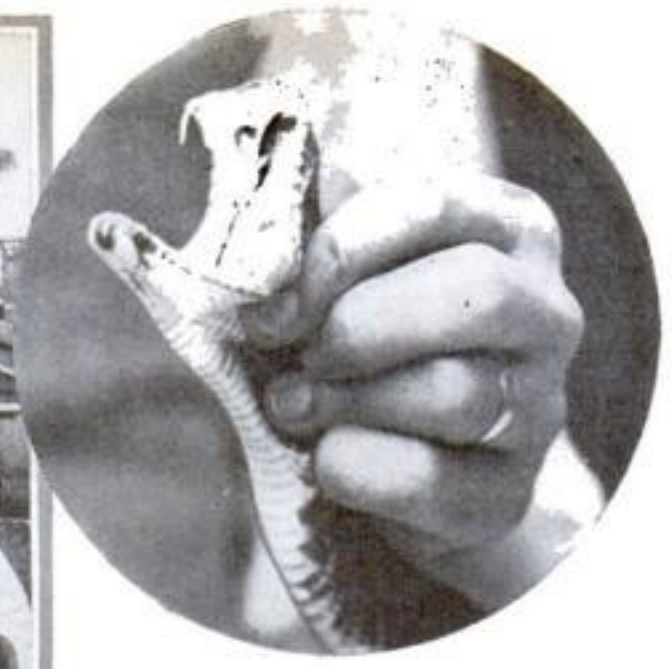
Spectacular as are these experiments of Dr. Peck, the work of Dr. Adolph Monaelesser is even more sensational. One of the founders of the Reconstruction Hospital in New York City and former surgeon general of the American Red Cross, Dr. Monaelesser has been using modified cobra venom for the relief of cancer sufferers.

While serving as an army surgeon, Dr. Monaelesser discovered the case of a leper who had been bitten by a tarantula. To the surprise of everyone, the venom of the spider brought about a marked improvement in the man's condition. Dr. Monaelesser began studying the effect of minute quantities of various venoms upon the human body and at last gave up his surgical practice and devoted his whole time to the venom treatment of cancer.

One of the first cases in which he used his sensational method was on a man suffering from cancer of the throat. The diluted cobra poison was injected hypodermically in an effort to deaden the excruciating pain. Shortly afterwards, the pain subsided and the cancer itself began to grow smaller. The patient, who had been on a liquid diet and had had to sleep upright in a chair, was able to eat solids and lie in bed.

Proceeding carefully, Monaelesser, with the coöperation of surgeons here and abroad, has carried on his work. Recently, the results of 200 treatments were reported to the French Academy of Medicine. They showed that in almost every

In order to secure the venom necessary to save those bitten by poisonous reptiles, snake farms have been established in various parts of the world. Above, the farm at Sao Paulo, Brazil, the first one established



The distended mouth of this reptile shows the fangs that discharge the poison into a wound as the rattler strikes

Left, skeleton of cobra. Note movable ribs that distend the skin to form the hood as the snake rears its head to attack

instance the pain was greatly reduced and when the injections were made after an operation for cancer, there was strong evidence that the venom treatments prevented the return of the malady. The injections are made every third or fifth day with a gradually increasing dosage. From Canada comes word that Sir Henry Gray also has used the modified cobra venom at a Montreal hospital with favorable results.

ANOTHER series of experiments with a venom cure was recently reported in the British medical journal, The Lancet. At the Port Elizabeth Snake Park, in South Africa, F. W. FitzSimons, the director, has spent several years studying the effect of blending venoms. His work was intended primarily for the treatment of snake-bite victims. But, researches have shown that venene, a preparation formed of several venoms blended together, is of value in epilepsy. It has been widely used in South Africa and a recent paper presented to a scientific society revealed that the results have been highly encouraging.

Before the World War, another combination of snake venoms, known as contratoxin, was tested in London, England, by Dr. F. Mehnarto. It was thought to have a solvent action upon certain microbes and was, in fact, tried with apparent benefit in cases of tuberculosis.

Behind the dramatic possibilities of these experiments lies the work of daring pioneers who have supplied the deadly poison needed for such medical work, have carried on the task of preparing antivenom, and have taught us what we know about the serpent poisons.

Snake venom, they have shown us, kills through the blood or the nerves. In the case of the water moccasin, the rattler and the fer de lance, it destroys the red corpuscles; almost literally turns the blood to water. The venom of the cobra and coral snake, on the other hand, strikes at the nerves, paralyzes the muscles and prevents breathing. The dreaded South American rattlesnake injects a whitish venom which, unlike the yellow poison of the northern rattler, attacks both blood and nerves. Antivenom which is effective

Poison taken from snakes is sealed in containers like the two shown below. In these it can be shipped long distances

against its bite is also effective against the venom of a North American rattler, copperhead, or moccasin. But serum capable of overcoming the poison of the northern snakes will not prevent death from the bite of a South American rattler.

ONE of the first symptoms of a bite by the tropical rattler is a twitching of the hands. Then the victim goes blind. He has to lie flat or choke. The muscles of his neck are paralyzed and his head swings like a ripe apple on a twig. This gives rise to the common belief that the bite of this snake breaks the victim's neck.

Bizarre symptoms also result from the bites of other snakes. The greenish venom of the fer de lance, for instance, causes blood to flow from the victim's eyelids. The fluid of the Texas rattler destroys the tissue of the flesh at the point where the fangs penetrate as effectively as though molten lead were poured upon the spot.

Yet just how these unusual symptoms are produced remains a mystery. Give an analytical chemist the deadliest of venoms and, according to Raymond L. Ditmars, curator of the Bronx Zoo, in New York City, and a foremost authority on the subject, his report will show no trace of poison. In his work with Dr. Monaelesser, Ditmars found that venom is slightly heavier than water and that it is composed of mucus and debris from membrane cells, carbon, sulphur, oxygen, hydrogen, nitrogen, some fatty matter and salts such as calcium chlorides and phosphates. Yet, every drop of this apparently innocent mixture is more deadly than strychnine though its poison remains hidden.

TO OBTAIN venom for medical and other experiments, Ditmars has "milked" thousands of deadly snakes of their poison. At one time, he was extracting the venom from 125 copperheads and moccasins regularly once every two weeks. Sometimes, he would handle a hundred snakes in a couple of hours and during the early work of producing antivenom he once supplied workers with a gallon of the deadly fluid from the fangs of North American reptiles. Much of this work was done in the days before antivenom was available, when the slightest slip was almost certain death.

Recently I watched him in this risky work, handling a thick-bodied moccasin on a table in a narrow runway back of the cages in the Bronx snake-house. Turning its blunt head from side to side, its mouth gaping open showing the white lining of its throat, the "cotton-mouth" was wriggling back and forth across the flat top of the table. It was fully four feet long. Its curved fangs, like deadly hypodermic needles, were hinged to the roof of its jaws, coming forward as it struck. The teeth of the rattlesnake are fixed to movable upper jawbones like twin stilettos, and fold back when the mouth is closed. Both are hollow to the points, carrying the venom from sacs located above the fangs. The moccasin *(Continued on page 118)*

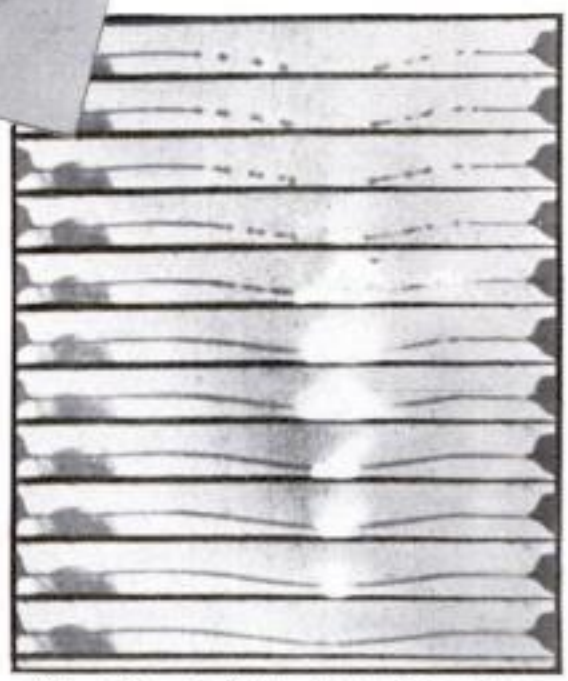
New Camera TAKES 80,000 Pictures a Second

SECRETS OF A FALLING DROP OF WATER

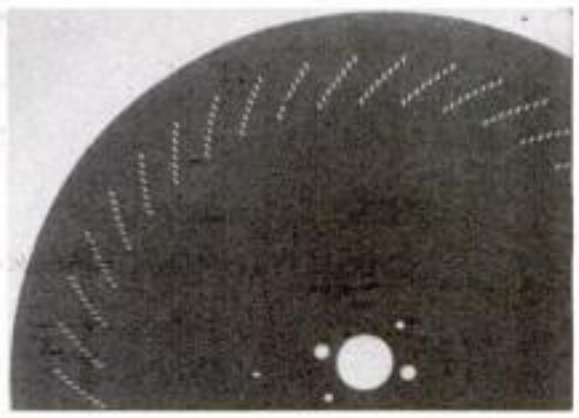
At top, using the speed camera, capable of taking 80,000 pictures a second, to photograph a falling drop of water. Strip above shows from left to right, the drop hitting the water; 2, the splash it caused; 3, drop reforming; 4 and 5, reformed drop rebounding; 6, falling back again

Above is whirling disk that carries the eight lenses used in speed camera

CAPABLE of taking as many as 80,000 pictures in a single second, a superspeed movie camera has been developed in Germany for industrial research. At such speeds, a drop of water falling into a basin is simple to photograph, and even the filming of an electric fuse as it burns out, showing the individual falling drops of molten metal, does not overtax the capacity of the remarkable instrument. Its use in the study of high-speed electrical and mechanical devices in actual operation is expected to solve long-standing problems of design, since the oscillations of a spring or the action of a valve may thus be clearly recorded. Instead of the single lens of ordinary motion picture cameras, the new instrument has eight separate lenses, which are mounted on a circular disk that is revolved at high speed by an electric motor. A second whirling disk,



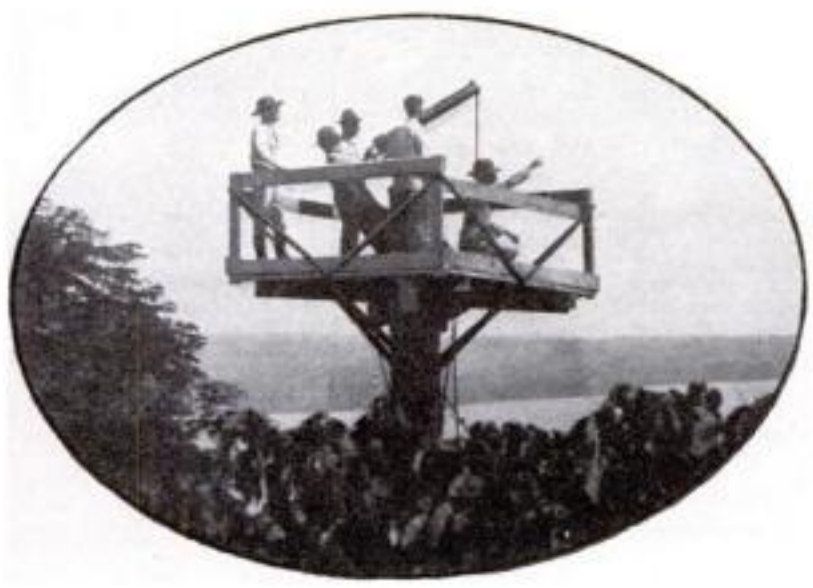
The series of views above show, from bottom to top, electric fuse burning out



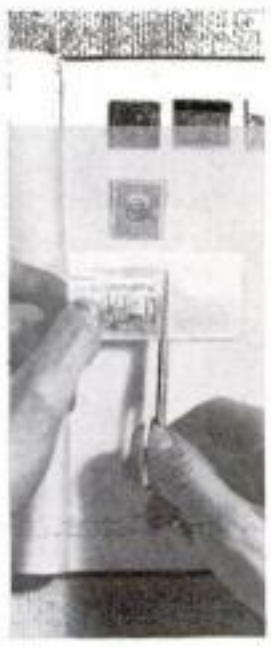
Revolving shutter with rows of eight perforations, which correspond to the lenses

pierced with rows of perforations, serves as a shutter. Each row contains eight perforations, one corresponding to each lens and allowing an image to be registered on a certain section of the moving film. The arrangement is such that in the time ordinarily consumed in making a single picture or frame, as many as eight pictures may be registered on subdivided parts of the film by the spinning shutter-lens combination. By this ingenious method of multiplication of images, the new camera can attain its extraordinary speed without requiring the velocity of the moving film to be raised to a prohibitive figure.

ANTI-AIRCRAFT GUNS IN TREE TOPS



METHODS of air defense peculiarly suited to the tropics have been devised by Army men in the Philippine Islands, where guyed poles support among the tree tops anti-aircraft machine-gun nests like the one illustrated at left. Thus a clear field of fire is provided, while the camouflage and shade of the tropical foliage are retained. Under service conditions, the gunners wear camouflaged clothing which hides them.



CELLOPHANE PROTECTS RARE STAMPS

FLAT tubes of transparent cellophane, gummed at the upper edge, now aid stamp collectors in mounting their specimens. A stamp is slipped into the tube and the desired length is snipped off as illustrated. The tube protects its contents from moisture in the air.

PORTABLE EQUIPMENT MAKES

Whole World a Movie Studio

A native of the South Sea islands serves as property man and camouflages a microphone with bananas to hide it while scenes are shot

By JOHN E. LODGE

INVENTORS of Hollywood are turning jungles, South Sea Islands, and icy wastes of the north into sets for the latest talkies. Thanks to their recent innovations, full-length features are now being produced, complete with sound, thousands of miles from the conveniences of the studio.

In the days of the silent pictures, a roving cameraman needed only a camera and plenty of film. With the coming of the talkies, all that changed. Soundproof studios had to be built and tons of equipment preceded a company on location. Now, however, by simplifying the sound apparatus, substituting duralumin for heavier metals, employing new type reflectors, and designing "break down" generators, technicians have reduced the weight of the equipment needed. Two men can set out today and search the far corners of the earth for screen drama with a complete outfit for recording it packed in a couple of trunks and a few small boxes.

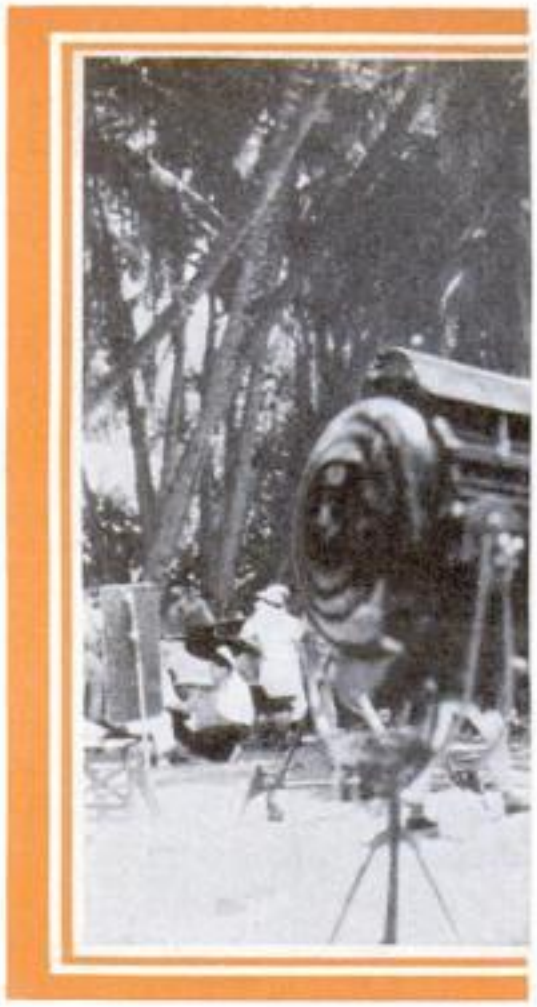
One such two-man company recently shipped back from the South Seas 40,000 feet of film, sealed in 200 tins, to form the backbone of the feature picture, "The Sea Girl." James B. Shackelford and George Dromgold were the men who

Here is all the equipment needed to take sound pictures: camera, microphone, amplifiers, battery

journeyed to the East Indies to get the film. The story of the handicaps they overcame and of the impromptu inventions they made illustrates the ingenuity required of these cameramen adventurers.

On one location, for instance, Shackelford found his supply of distilled water running low. "To avoid costly mistakes," he told me, "we always use distilled water in developing the films. Neither in the tropics nor on the desert can we be sure our water supply is free from alkali and acids."

Instead of fretting over the situation or waiting for bottled water to arrive from a distant port, Shackelford coiled thirty feet of copper tubing in a five-gallon gasoline can, attached one end to a two-gallon oil can and ran the other into a milk bottle. He then filled the two cans with



With a portable outfit a sound

water and his homemade still was ready for action. By turning a blow torch against the two-gallon can, he was able to create enough steam to condense two quarts of distilled water every hour!

During one scene, the men found they needed some means of turning quickly when making running shots in close quarters in the forest. So they devised a three-wheeled dolly which rolled silently along on three planks laid through the heavy growth. At the end of the planks, both camera and sound apparatus could be swung around in its own length by one man, ready to continue the thrilling chase.

Complete with portable batteries, which operate the camera and sound-recording mechanism, such outfits weigh less than 250 pounds. They are so simple that Polynesian natives, who had never seen a movie camera before, were able to operate them, pushing buttons to start and stop them at signals from the busy movie men. In fact, three of these portable cameras, with a separate circuit for the microphones, recorded scenes at New Guinea just as faithfully as the intricate equipment of a giant Hollywood studio brings sights and sounds to the screen.

Two ribbons of duralumin vibrating in a magic black box bolted to the rear of the camera do much to make such feats possible. It is the black box, known as a modulator unit, which recently has eliminated many of the difficulties of sound recording.

Complete, the box weighs only three pounds. It consists of two lenses, a light valve, light, and magnet. All that is needed to run the device is a six-volt battery which can be recharged easily. In an emergency, an automobile battery will do.

The cameraman bolts this modulator unit over an opening at the rear of his camera. The two ribbons operate in a

picture is shot with genuine Hawaiian scenery as a realistic background

Below, fastening palm leaves to an electric light pole in Elevala, Papua, to make it look like the native scenery

Sound and Picture Outfit Now Carried to Any Spot, Complete for Work, in Two Trunks and a Few Boxes

magnetic field. They move apart or come together as the sound current varies. Light, coming from the camera lens, passes between them and reaches the sound track of the film in varying amounts. This variation produces the wavy line which records the sounds picked up by the microphone.

Pictures and sounds are recorded on separate films which roll through the cameras at a constant speed of ninety feet a second. This permits them to be cut and matched when the experts in the Hollywood cutting room begin their work of assembling the completed picture.

To increase the fidelity and range of sound reproduction, another innovation was recently made. It enables the roving director to catch exactly the different shades of sound that occur on an out-of-the-way location. It is known as the bilateral sound track. This means that the light creates waves on both sides of the narrow celluloid track instead of on a single side as in the past.

During a recent tropical jaunt, another cameraman, Karl Struss, discovered that, with the nearly silent cameras now in use, the 350-pound "ice-boxes" used in the studios to shut in the sound are unnecessary. He flung a canvas cover over his apparatus and found it was adequate to kill the faint clicking of the modulator unit.

Sometimes the picture-makers in faraway places move headquarters daily, searching for unusual native characters and scenic backgrounds. Shackelford, for example, sailed for five months in and around Torres Straits, Thursday Island, Australia, the Arefura Sea, and the islands of China Straits before he found, in New Guinea, the location he was looking for. Maps, several wandering directors have told me, prove inadequate on such trips, often showing points 150 miles from their geographic locations. Consequently, they make it a habit to take bearings from the sun and stars and to check their watches regularly from signals broadcast by radio.

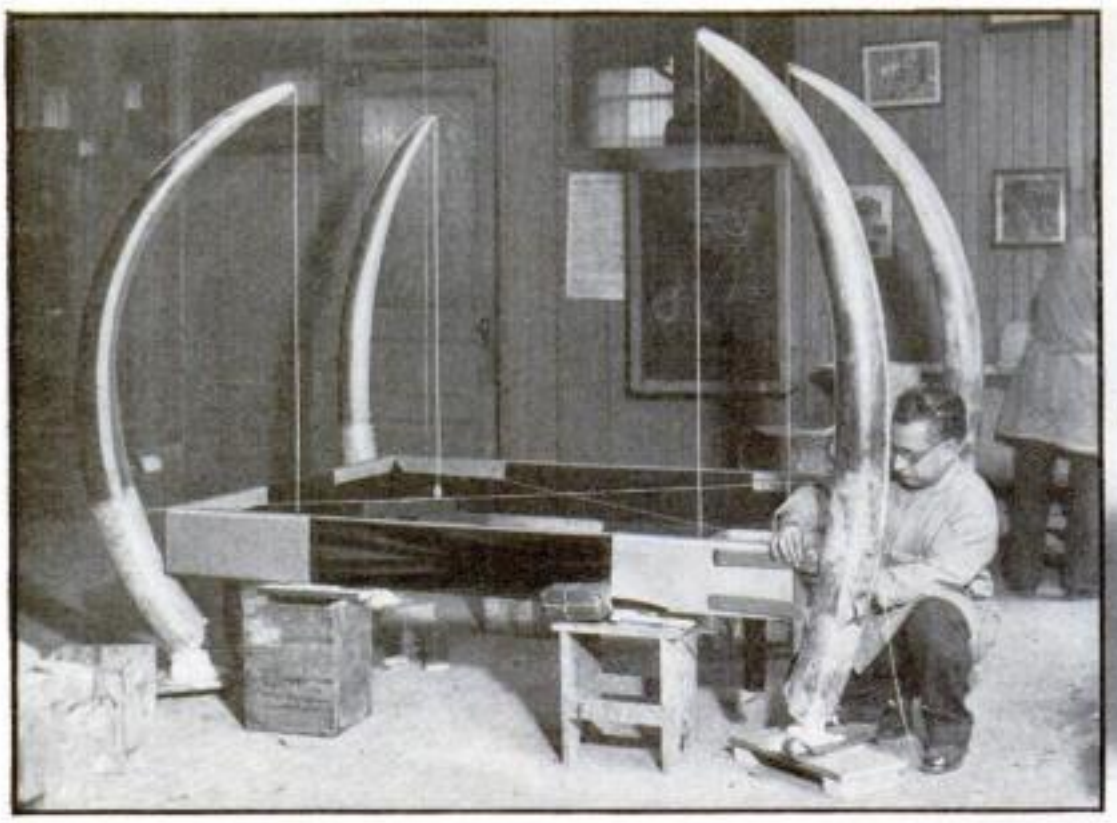
In the Arctic, the cold makes the film used in the cameras brittle; in the tropics, the humidity brings out the grain and shrinks the film unless preventive steps are taken. Sometimes in the tropics, the celluloid strips actually go limp in the cameras. Shackelford discovered that by dehydrating the film with calcium chloride he could preserve it easily and by sealing it again and returning it by early boat to Hollywood, he could make sure his costly drama would reach the screen.

One unexpected complication in filming "The Sea Girl" was a telephone pole in New Guinea. The town of Elevala, on the south coast, had been chosen as an ideal setting for a scene. Some time before, the pole with an electric light attached had been set *(Continued on page 113)*

Water Distilled in the Wilderness

To get distilled water for the battery and dark room, mechanics used a torch to heat water in a can and condensed it in a coil rigged inside a gasoline container

BIG GAME TROPHIES USED TO MAKE UNUSUAL FURNITURE

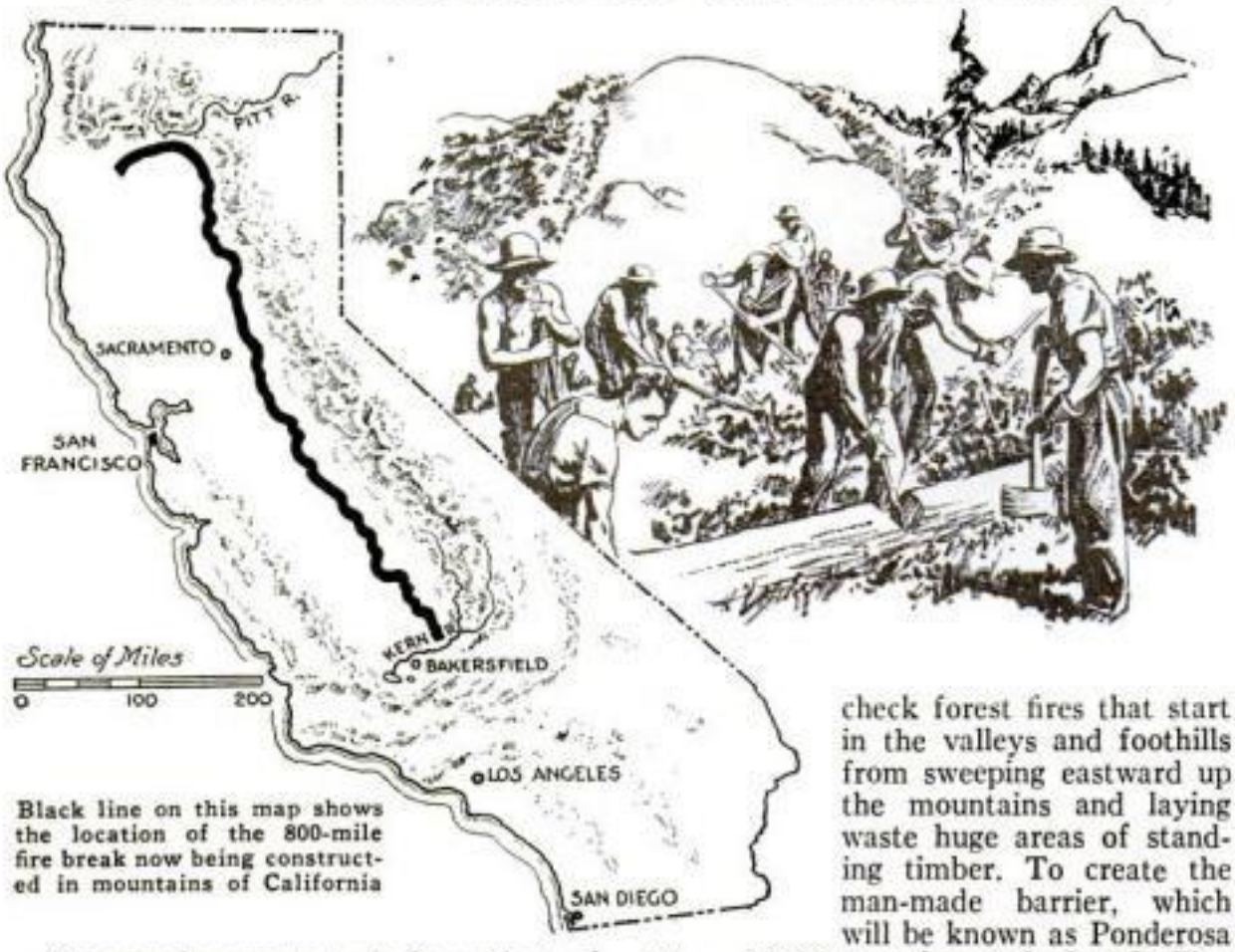


New style is set in furniture by using the tusks of elephants as posts for a bed. The photo above shows the designer of the unique furniture attaching the tusks to the frame

By turning big game trophies into furniture, a New York designer has created a new and original style of craftsmanship. Elephants provide him with a variety of materials, as shown by the accompanying photographs. Four tusks, matched and mounted, serve as the posts for a bed, and a section of elephant hide provides a top for a taboret. The stuffed foot of an elephant becomes a smoking stand.

At left is a taboret with its top covered with elephant hide. Below, smoking stand from elephant's foot

BIGGEST FIRE BREAK 800 MILES LONG

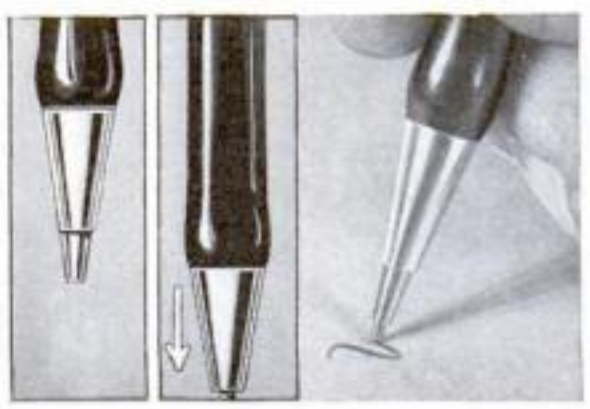


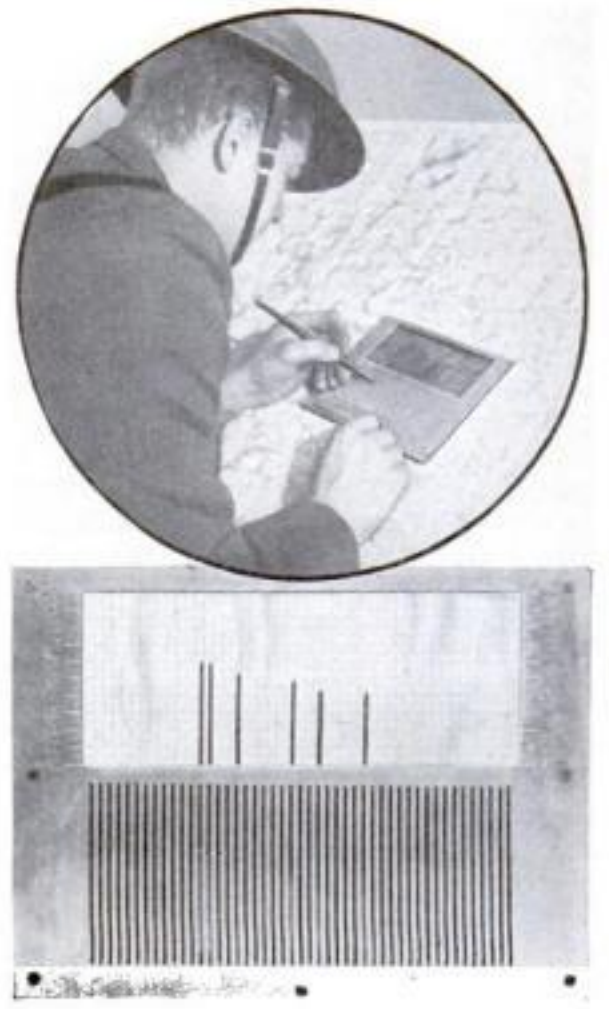
Black line on this map shows the location of the 800-mile fire break now being constructed in mountains of California

Called the greatest single project of its kind ever attempted, a monster fire break 800 miles long is being constructed on the western slope of the Sierra Nevada Mountains of California by the U. S. Forest Service. When completed, it will check forest fires that start in the valleys and foothills from sweeping eastward up the mountains and laying waste huge areas of standing timber. To create the man-made barrier, which will be known as Ponderosa Way, 16,000 members of the Civilian Conservation Corps are clearing all inflammable brush from about two thirds of a billion square feet of virgin forest land, and cutting away the lower limbs of standing timber.

PRESSURE SHARPENS MECHANICAL PENCIL

To sharpen it, the user of a new mechanical pencil has merely to press its tip against a table-top. When the pressure is released, a spring clutch automatically thrusts the lead forward and then locks it. The pencil is provided with a pocket clip which is extended by twisting the barrel. When tripped, it snaps down upon the edge of the pocket.



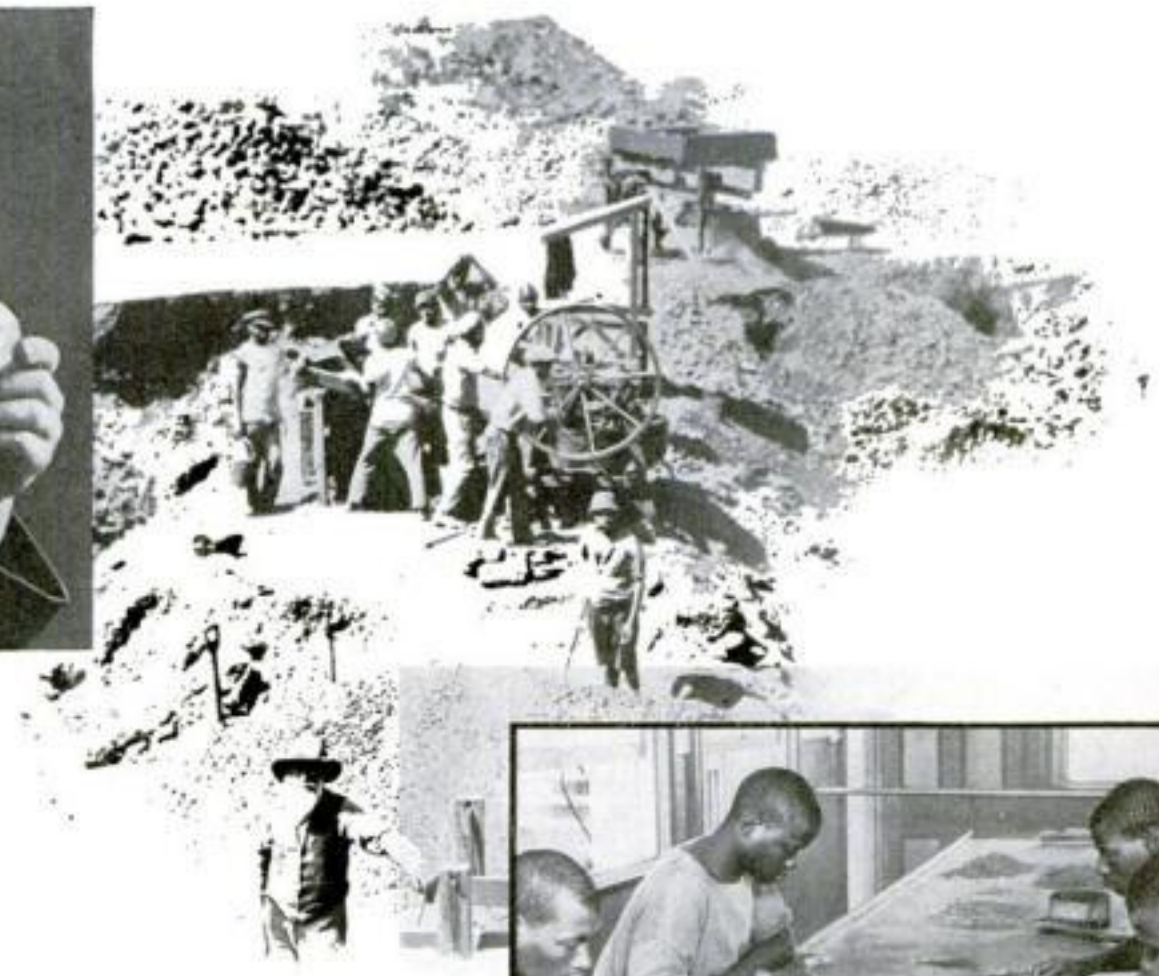


MAP-READING DEVICE AIDS ARMY GUNNERS

As an aid in visualizing the contour of the ground from a map, a quickly read indicator has been devised for military and other uses by H. G. Hamilton, of Des Moines, Iowa. In use, the device is placed directly on the map as shown in the upper view. By moving the adjustable pointers, shown in the lower picture, to the proper elevations on a vertical scale, an accurate representation of the profile of the ground is instantly obtained. Thus the instrument permits the quick and accurate solving of visibility and artillery fire-control problems, and may also be used by surveyors in plotting road cross sections and the vertical variations of a traverse.

Laborer Finds $315,000 Diamond

The fourth largest diamond ever found has just been unearthed in Africa. It weighs 726 carats and won its owner a fortune

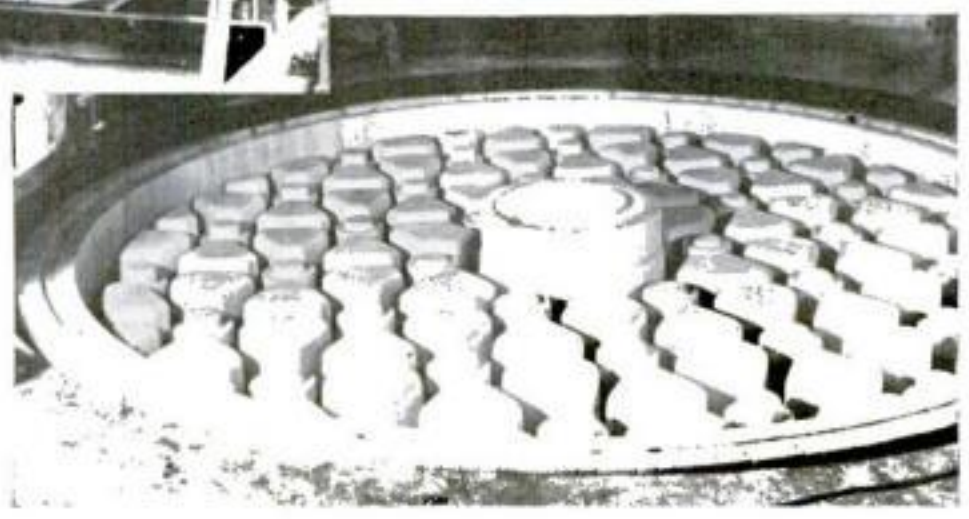


At top, screening river gravel to recover diamonds it may contain. Above, inclined table at which native laborers sort out the small diamonds from the gravel

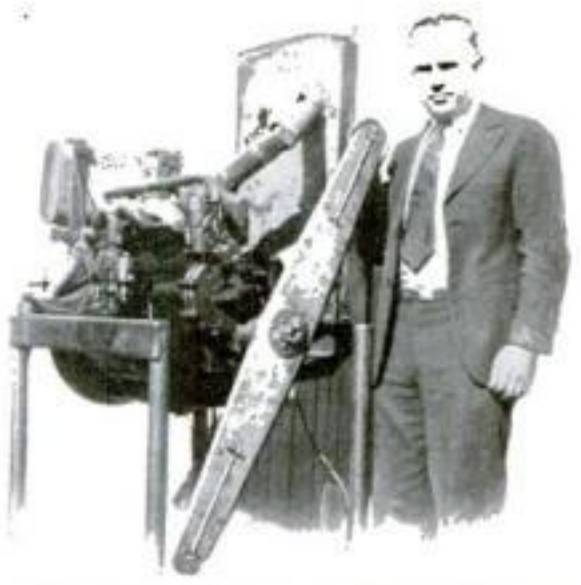
DIAMOND history was made recently when a native laborer discovered a flawless blue-white diamond weighing 726 carats on the diggings of J. J. Jonker, a poor prospector, at Elandsfontein, South Africa. Large as a hen's egg, the stone was immediately bought by a diamond firm for $315,000, with a part of which the lucky sixty-two-year-old prospector planned to realize his life's ambition of buying a sheep and cattle ranch. Only three times before in history have larger stones been found. The biggest, the Cullinan Diamond, weighed 3,025 carats before it was cut; the Excelsior, 969½ carats: and the Great Mogul, 787 carats. With the finding of the Jonkers Diamond, as it has been christened, prospectors are rushing from all parts of Transvaal in the hope of similar discoveries. Two general methods are in use for mining the gems. In many parts of South Africa they occur in river gravel, which is washed and screened. Most of the diamonds of commerce, however, come from the curious volcanic pipes of blue ground typified by the Kimberly diggings. Here deep shafts are driven, the earth being brought to the surface and washed.

MOLD FOR BIGGEST TELESCOPE MIRROR

TWENTY tons of molten glass were ready to be poured, at this writing, to form the largest astronomical mirror in the world for the California Institute of Technology's 200-inch telescope. For the casting of the huge mirror, experts of the Corning, N. Y., glass works have prepared a mold seventeen feet in diameter and studded with a curious pattern of projecting knobs. A cylindrical projection at the center will leave a hole for optical purposes. The surrounding knobs will produce a pattern of strengthening ribs on its under side.



Above, 120-inch trial mirror, poured to test method to be used for casting the big 200-inch mirror. Right, mold for world's biggest mirror. The knobs form ribs and the high center leaves a hole for optical uses



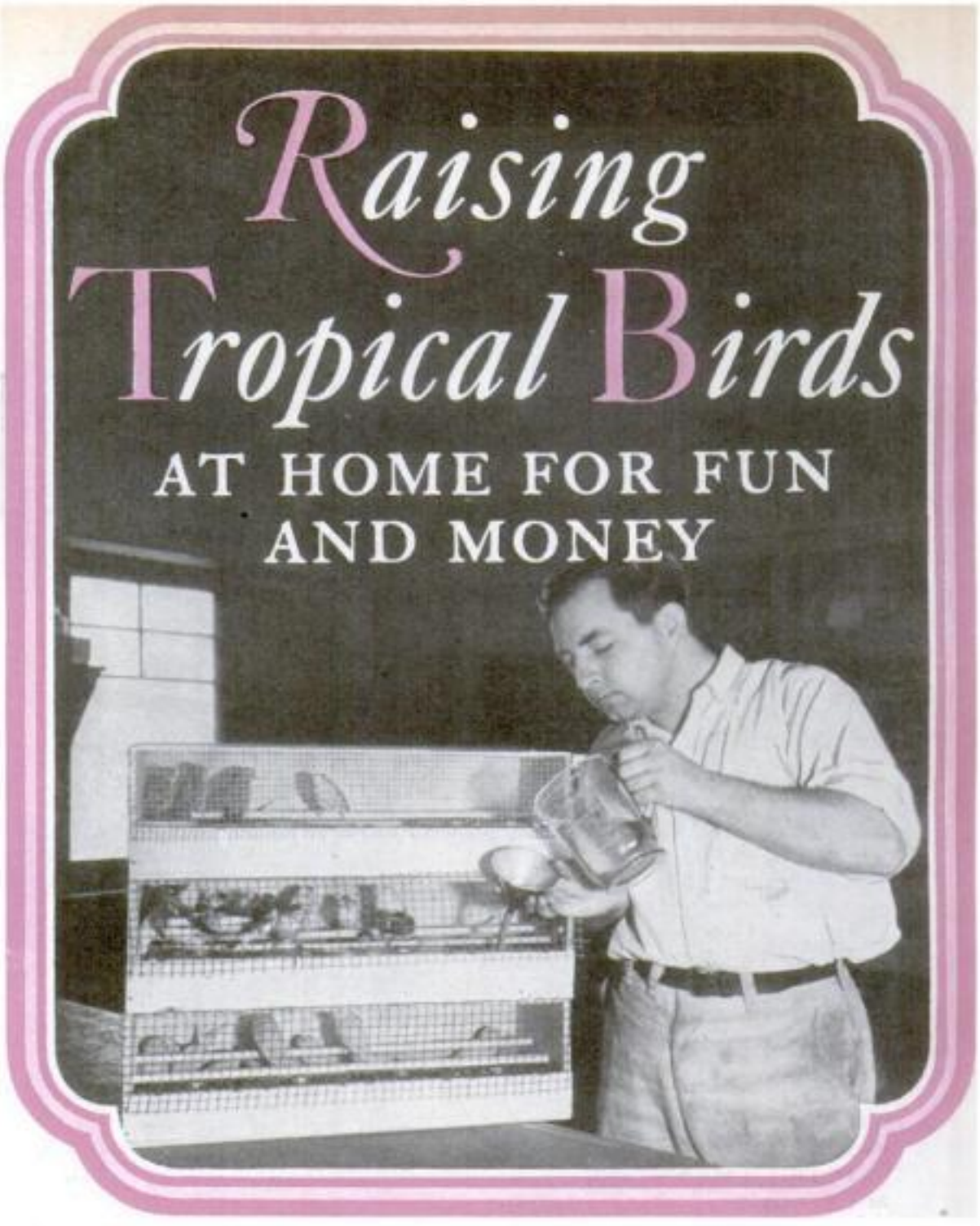
WHIRLING NEON LIGHTS HELP FLYERS IN FOG

BY INSERTING two neon light tubes in the ends of a small wind-driven propeller, a new type of fog-penetrating light has been created for use on planes. Miniatures of the device have been installed in the leading edge of wings on transport planes and are now being tested. When two planes approach, a red or green light is seen on each wing. By using a cone on the ground a shaft of light may be projected to guide pilots in a fog.

African love bird, six weeks old, is so tame it will perch on its master's finger unfrightened

Raising Tropical Birds

AT HOME FOR FUN AND MONEY



In these tiny boxes, birds may be shipped long distances with perfect safety. Their food is placed on the bottom of the boxes and their nonspillable cups are filled with water each day

By
FRANK FLOWERS

Conditions Under Which Feathered Pets Will Thrive Are Described by Expert

DEEP in the heart of India, runners search the forests for Spice Finches, that their modest colors may grace American aviaries. On the fringe of another distant forest, Australia's national bird, the kookaburra or laughing jackass, tries vainly to evade the net of his would-be captor, little thinking that one day he will mock an American owner. The toucan projects his jutting proboscis and scolds unwanted visitors in his South American home. In China the man-made Society Finch, which knows no wild ancestors, struts and chirps as he rears numerous families.

From the grassy plains and forests of tropical regions, many rare and beautiful birds have been delivered to American homes. During the last few years home breeding of these feathered beauties, many of them comparatively unknown a decade ago, has attained the proportions of big business. These little creatures thrive happily in captivity, living to an age which their wild cousins cannot attain while battling the forces of nature.

These strangers may be reared easily by the amateur bird fancier. Generally the rules applying to one variety are suitable for any other. Whether your interest runs to exotic unknowns or to the parrot, finch, or canary types, you will find them easy to breed and raise provided you observe a few simple suggestions and keep them warm, clean, and properly fed.

You may choose from a wide range of color combinations and varieties. There are more than 200 types of finches alone. Possibly a parrot-type bird interests you. Though the originals reached American shores from Australia, the Shell Parrakeet, known also as the love bird, is by all odds the most popular today. The parrakeet's engaging mannerisms, hardiness, and free-mating propensities make it an ideal subject for breeding.

The Mexican red cardinal, kookaburra, and the toucan may object to entering captivity, yet, like all birds, they soon settle down to domestic felicity and in due course will reward their owner by bringing young into the world. The kookaburra is very rare in this country. I know of only one pair. These are hardy youngsters which recently reached our shores in good health after the long voyage from their native land.

I have known many "queer birds"—but none stranger than the toucan, whose long beak looks as though it would pull him off balance without warning. He gets along nicely, however, both afoot and on the wing; and with proper feeding and care will make life interesting for his owner.

Like the toucan, most birds now gracing private cages and aviaries are tropical in origin, yet some of them have been known so long that people think of them as native to this country. For over a half-century the Shell Parrakeet has been one

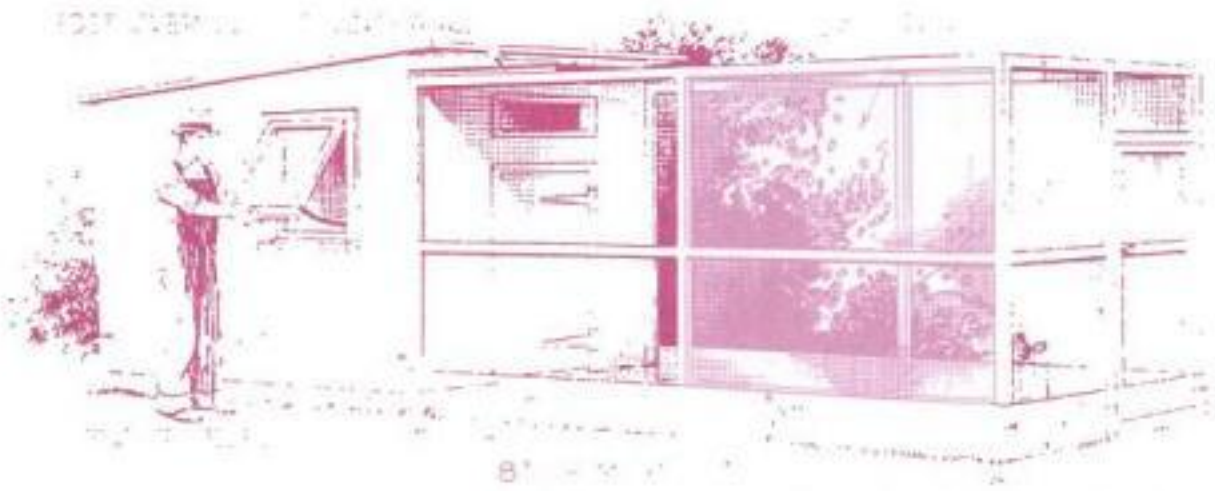


Illustration showing dimensions and general appearance of a fourteen-foot aviary that is ideal for breeding birds. A partition lengthwise makes it capable of housing two families

of the most popular birds for cage and aviary. This variety probably outnumbers all others of the parrot family.

Every owner wants his bird family to multiply. To insure this select unrelated stock. You will find it pays to obtain the finest available. Otherwise the second and third generations may revert to scrawny types, unlovely and frail.

Success with your birds depends largely on proper and sanitary surroundings. You must decide whether an out-of-door aviary or an indoor cage will be used. Fortunately it is wholly unnecessary to invest a large sum in expensive equipment for either type of home, whether you are planning the domicile of a single pair of canaries or two score parrakeets. You will derive your pleasure in planning and building your own breeding cage or aviary and in tending your little flock once it arrives.

Home-built aviaries are surprisingly simple and inexpensive. For the small, in-door aviary, first make a base by nailing onto two timbers measuring one and three-fourth inches by three-fourths inch a three-ply veneer board eighteen inches by twenty-four inches. Then complete the frame of the box-like structure to fit overall specifications of twenty-four inches in height by a width of twenty-four inches and a depth of eighteen inches. Cover each side with one-half inch-square mesh-wire fabric, painted green for better visibility. Nail a piece three-fourths inch by three-fourths inch in front over the pan, to which the wire fabric is securely nailed above the pan. For a door, cut an opening three inches by four inches in the fabric in the exact center of the front, hanging a piece of wire fabric four inches by five inches over the opening so as to swing outward. The pan, of galvanized sheeting, should fit the floor of the cage.

The outdoor aviary may be varied in architecture and yet present the essential features. Such an aviary will protect the birds adequately against cold weather. An aviary large enough for fifteen pairs of finches or ten pairs of parrakeets consists of a sloping-roofed house and flight, fourteen feet long, six feet wide, and seven feet tall. It should have a window, with a flight entrance cut over the door leading to the screened section. The flight pen is eight feet long. In sections visited by heavy snows, the roof should be pitched to an angle of forty-five degrees.

Solid roof should extend three feet from the house out over the screened section to protect the flight entrance against rain and snow. No other formal instructions need be followed other than to build the outer part of light materials and small-meshed screen, to extend about eight feet from the house. An aviary of this size is ideal for any small birds, but it is best not to mix varieties for safety in breeding. By running a partition lengthwise through the center, thus making two compartments, you may easily divide the varieties.

Green shrubs, when planted in the flight, make the aviary more attractive. The birds appreciate it. Whenever possible, use rustic boughs for perches instead of milled lumber, as they are more ornamental and make the birds feel more at home. Always hang the nest boxes in the enclosed section.

Close the birds up at night in both summer and winter, as stray cats bother them if they are left in the open flight. Keep the ground covered with clean dirt or sand to avoid disease. You may keep the feed hopper on a shelf under the window in the enclosed part so the birds will have plenty of light on their seed.

You need not build a formal aviary, however. Many people of my acquaintance use spare rooms and screen porches by placing wire netting over the windows and sand on the floor. Other suitable places are the attics of houses or barn and the flat roof of an apartment house.

If possible, arrange some means of watching your birds, unobserved, at play. In our bird sanctuary at Reseda, Calif., I can observe most of our 10,000 beauties through dual peep holes in the walls of the breeding aviaries. Each pair of peepers is shielded by a metal flange, which gives them the appearance of the old-fashioned steropticon. One doesn't enjoy birds till he sees them, not through a show *(Continued on page 120)*

Baby finches like this one can be tamed to rest on the finger if they are carefully handled while young

One of the oddest of the small birds is the toucan, whose enormous bill always attracts attention. They are popular in any aviary

With a peep sight in your aviary, it is possible to watch the birds at play without disturbing them

If a bird suffers a broken leg, it will generally heal rapidly if quills are cut the proper length and used as splints to hold the bones in place

Below is the right kind of a box nest for love birds. Here one is seen taking its first look at the world. The nests may be built of waste boards

This gourd has been turned into a nest for a love bird. Such nests are ideal and furnish good protection

MYSTERIOUS SEA MONSTER FOUND DEAD

Twenty-five-foot sea monster that was cast up dead on the shores of France. It had a head like a camel, a long neck, and a split tail. Scientists are dissecting it but thus far have failed to classify the creature

CAST up dead on the shore near Cherbourg, France, a strange sea animal with a head like a camel, a long neck, two shoulder fins, and a split tail has provided a puzzle for scientists. Its length of twenty-five feet entitles it to be described as a sea monster, while its shape resembles that of no known species. The carcass was mutilated by waves and sea birds soon after being washed ashore. Fortunately, the first arrivals at the scene obtained photographs that may aid scientists in classifying the new monster which is now being dissected.

RENEWABLE CLEANING STRIP IN NEW TOOL

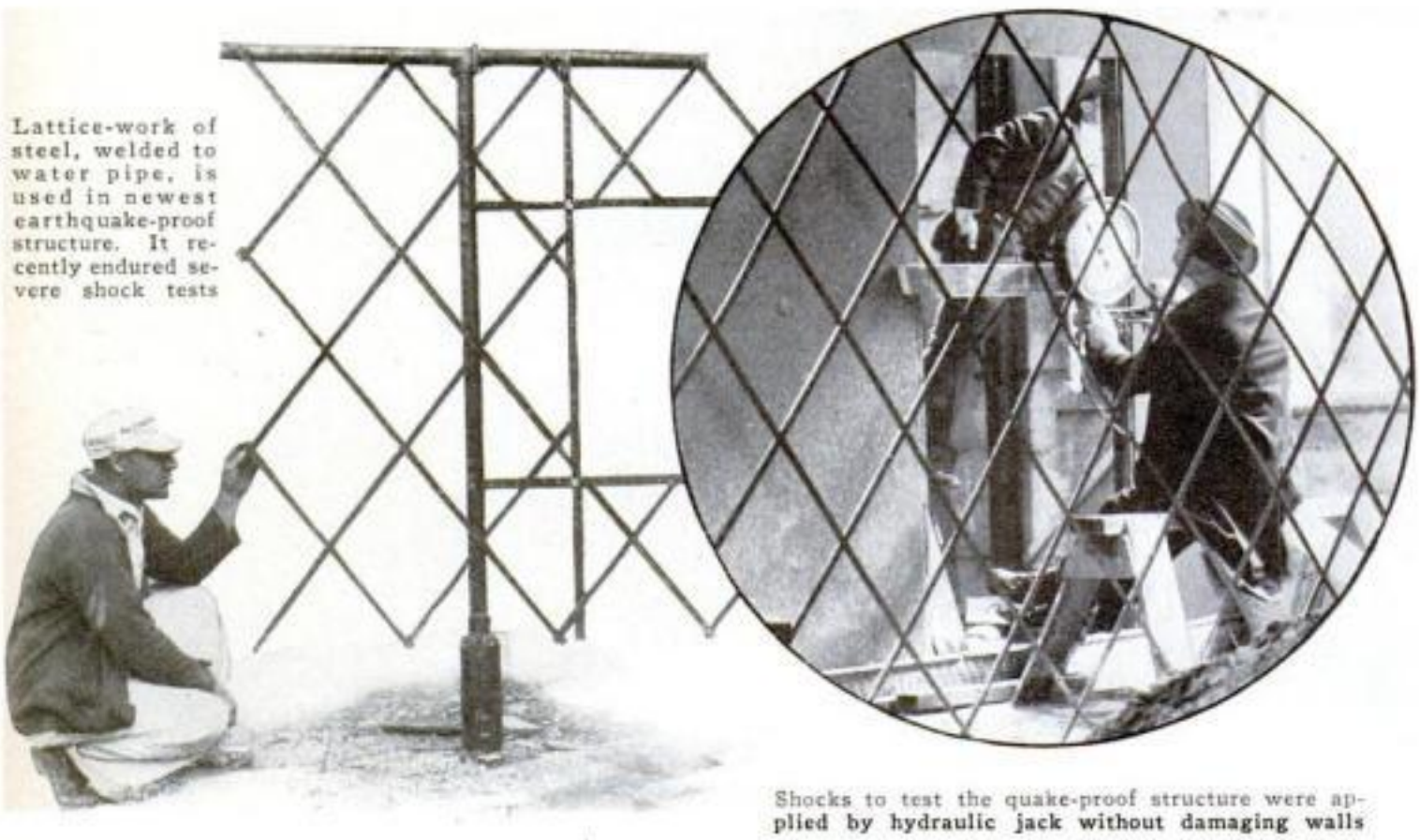
USEFUL for dry-cleaning suede shoes, or for sanding wood surfaces, is a new tool that uses a renewable strip of abrasive. The strip is fed from a central roll around the circumference of the block, and is clamped at the ends for use. When it is worn a new strip is pulled into place.

BLACK LIGHT GUARDS BABY

DESIGNED to foil would-be kidnapers, a baby's crib, guarded by rays of invisible light, was exhibited recently in Chicago. Draperies at the foot of the bed conceal a lamp producing black light. Its rays are focused upon a sensitive electric eye. When the baby is lifted, a bell rings.

Above, concealed relay that operates alarm on baby crib. Left, bell rings if baby is lifted

EARTHQUAKE-PROOF STRUCTURE WITHSTANDS HARD SHOCKS



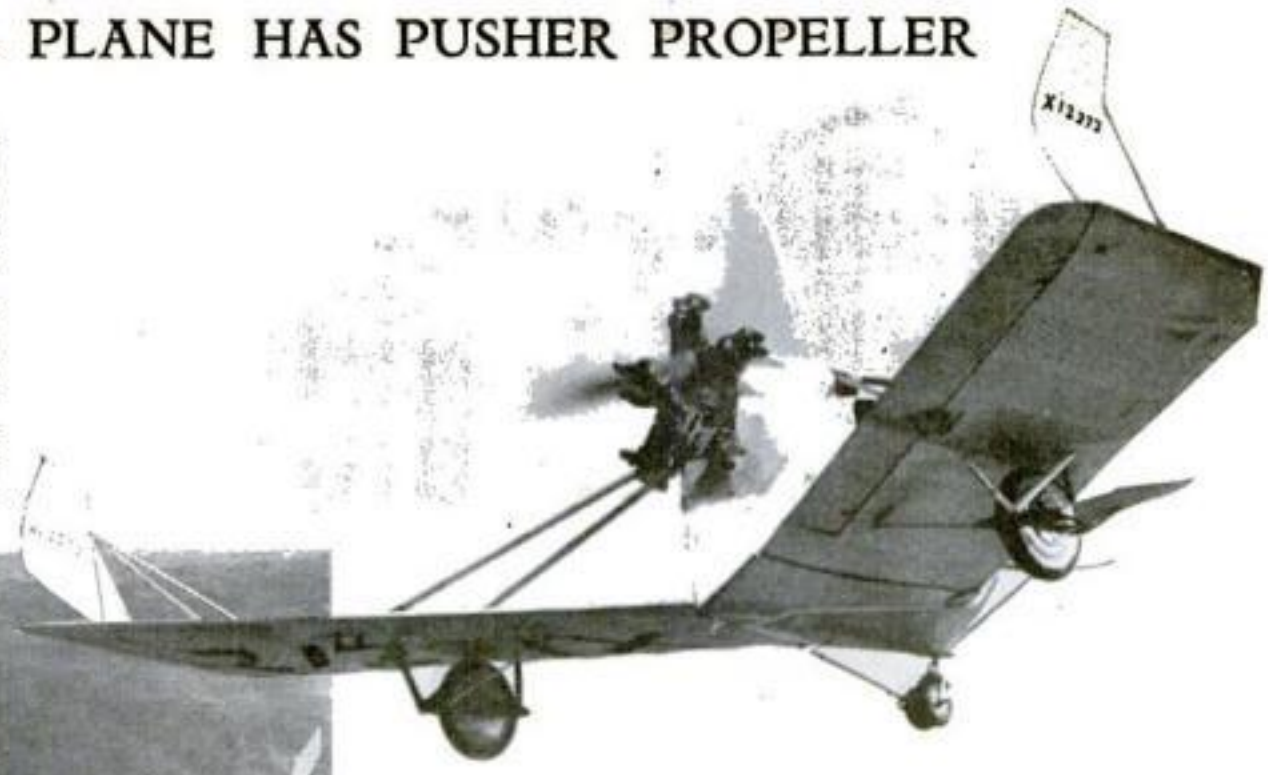
Lattice-work of steel, welded to water pipe, is used in newest earthquake-proof structure. It recently endured severe shock tests

Shocks to test the quake-proof structure were applied by hydraulic jack without damaging walls

A NINE-by-fourteen-foot test wall, complete with door and window, embodying a new form of earthquake-proof construction suitable for houses and schools, has just undergone successful trials at the California Institute of Technology. The trial section, employing a diagonal lattice-work of steel electrically welded to a framework of steel water pipe set in concrete, was declared virtually undamaged when a hydraulic jack applied the severest shocks ever given a full-sized wall panel of any material. The new system is said to be economical.

TAILLESS FLIVVER PLANE HAS PUSHER PROPELLER

SUCCESSFUL in its first flying tests, a tailless plane, to be manufactured at a price within the reach of any aviation enthusiast, has been designed by Waldo D. Waterman, former air-mail pilot and veteran airman of Santa Monica, Calif. The odd machine seats two persons and is said to have flown at more than 100 miles an hour. The power plant is a light-weight radial motor of air-cooled type, operating a pusher propeller at the rear of the craft between the V-shaped wings.



New tailless, pusher-propeller type plane caught by camera during a test flight. It is said to attain a speed of 100 miles an hour

At left, view of tailless craft which has been designed to meet popular demand for a cheap and safe plane

STALACTITES FORM IN OLDEST SUBWAY

USUALLY associated with caves of great age, stalactites are now forming in a subway tunnel in London, England, and provide a geological curiosity for visitors to this old shaft. The tunnel was used for the world's first subway, built in 1890, and carried its last train thirty-five year ago. Meanwhile water seeping into the tunnel from limestone beds above has created icicle-like pendants that become longer each year forming beautiful stalactites.

SOAP-BUBBLE GLASS IN ULTRA-VIOLET BULB

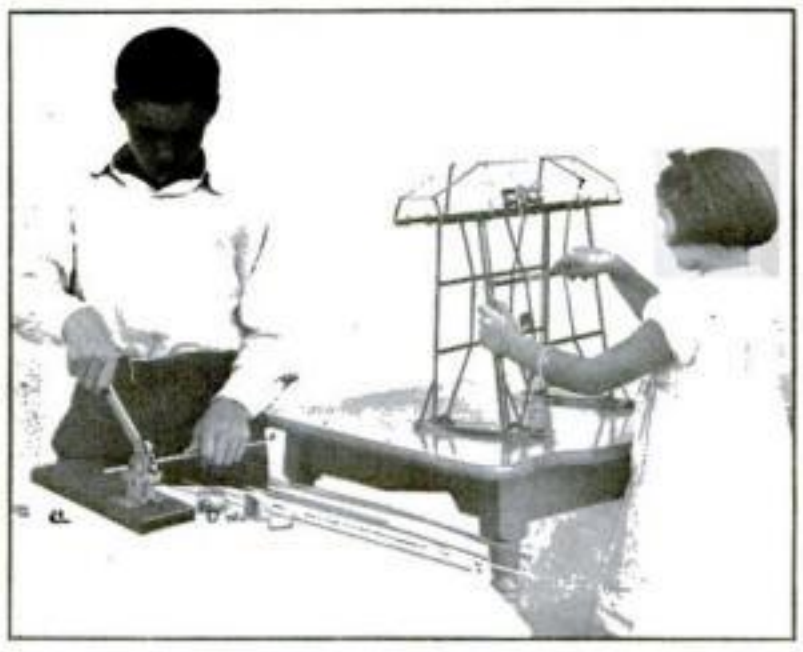
THOUGH ultra-violet light will not penetrate ordinary window glass, it passes with ease through the window of glass only two ten-thousandths of an inch thick in a new lamp bulb for home use designed by Westinghouse engineers and shown above. Thin as a soap bubble the window does not break because of its surrounding support of standard glass.

RIBBED RUBBER GLOVES HOLD DISHES SECURELY

HOUSEWIVES who wear rubber gloves while washing dishes may now obtain a new style with non-skid fingertips. Rough-surfaced rubber gives a firm grip on glasses or dishes, as shown in the illustration above, reducing the danger that they will slip from the hand.

NEW CONSTRUCTION SET HAS MANY USES

ANY youngster can make his own parts for constructing miniature buildings, railways, and derricks, with a construction set just placed on the market. Flat steel strips serve as the material. These are cut, punched with holes, or bent into a variety of shapes by a versatile combination tool supplied with the outfit. The tool also cuts and threads bolts, wire, or axles. According to the maker, a boy may thus assemble an unlimited variety of models along his own plans, without being cramped by the limitations of ready-made parts of buildings.



Construction kit, containing flat steel strips and a tool with which to bend material, makes the building of many toys easy

Slanted Oil Wells

Strange Tools Revolutionize Drilling and Open Way to Development of Fields Under Mountains or Beneath Sea's Floor

The large-toothed circle in the photo above is the rotary table that grips the drill pipe and imparts a turning motion to the bit. By tilting this table, the well can be deflected right from the start

By Sterling Gleason

SLANTED oil wells are the latest sensation of the oil industry. Drilled by experts who use special tools and secret methods to send the bit burrowing into the ground at strange angles, they are finding amazing new applications. They are being used to harness wild wells that cannot be controlled from above; to turn the bit aside when tools have become stuck in the hole, and to tap subterranean pools lying beneath deep lakes or inaccessible peaks. In the hands of scheming drillers, they have even been used secretly to cross property lines and filch state-owned oil lying beneath the floor of the ocean.

Only a handful of men in the world have the strange power to make a bit, rotating a mile below ground at the end of a steel drillpipe, snake its way in a curve or around a dog-leg angle, to reach a desired objective. Their wizardry is made possible by the use of new scientific eyes that see what the bit is doing and telegraph the information to the surface; by universal-jointed bits that feel their way around curves; by robots that automatically control weight on the bit with a feather-light touch, keeping it straight or making it worm its way off on a new slant. Acid-filled bottles plunge downward to sound the depths of tilted holes. Automatic cameras, controlled by gyroscopes, travel into the depths of wells, snapping pictures and charting the well as they go toward the bottom.

Brilliant work by a specialist in the new science of directional drilling, has just saved a whole oil field from ruin. A spectacular wild well was spouting oil, gas, and water with volcanic fury from a huge crater more than a hundred feet across. Alexander No. 1, thundering giant of the Conroe field in Texas, was out of control.

The trouble began when gas pressure from below, seeping up around the pipe, suddenly erupted to blow a funnel-shaped hole around the well casing. A torrent of mud and water followed. Before oil men could get to the runaway well, they saw the whole derrick, with its Christmas tree of pipe fittings and valves, vanish into a cauldron of mud, water, and oil.

Crews dragged the crater with wire lines but could not reach the valves. Meanwhile the hole had widened into a seething crater more than 150 feet in diameter. Oil at the rate of seven thousand barrels a day overflowed to form a huge, oil-topped lake nearly fifteen acres in area and still spreading.

Major oil companies who owned surrounding properties were alarmed. Their own wells, beaned down to a small production under order of the State Railroad Commission, were being robbed of their share by the runaway well. An enormous quantity of gas, escaping into the air, was rapidly running down the pressure of the field like a punctured automobile tire. Meanwhile, heavy clouds of gasoline-laden vapors swept over the whole district, carrying a threat of fire.

The Humble Petroleum Company invited other operators to join them in a desperate attempt to check the wild well. For $300,000, they bought the lease, crater and all. The drillers could have all the oil they could salvage until the well was brought under control. Already they had skimmed more than a million dollars' worth from the surface of the pond.

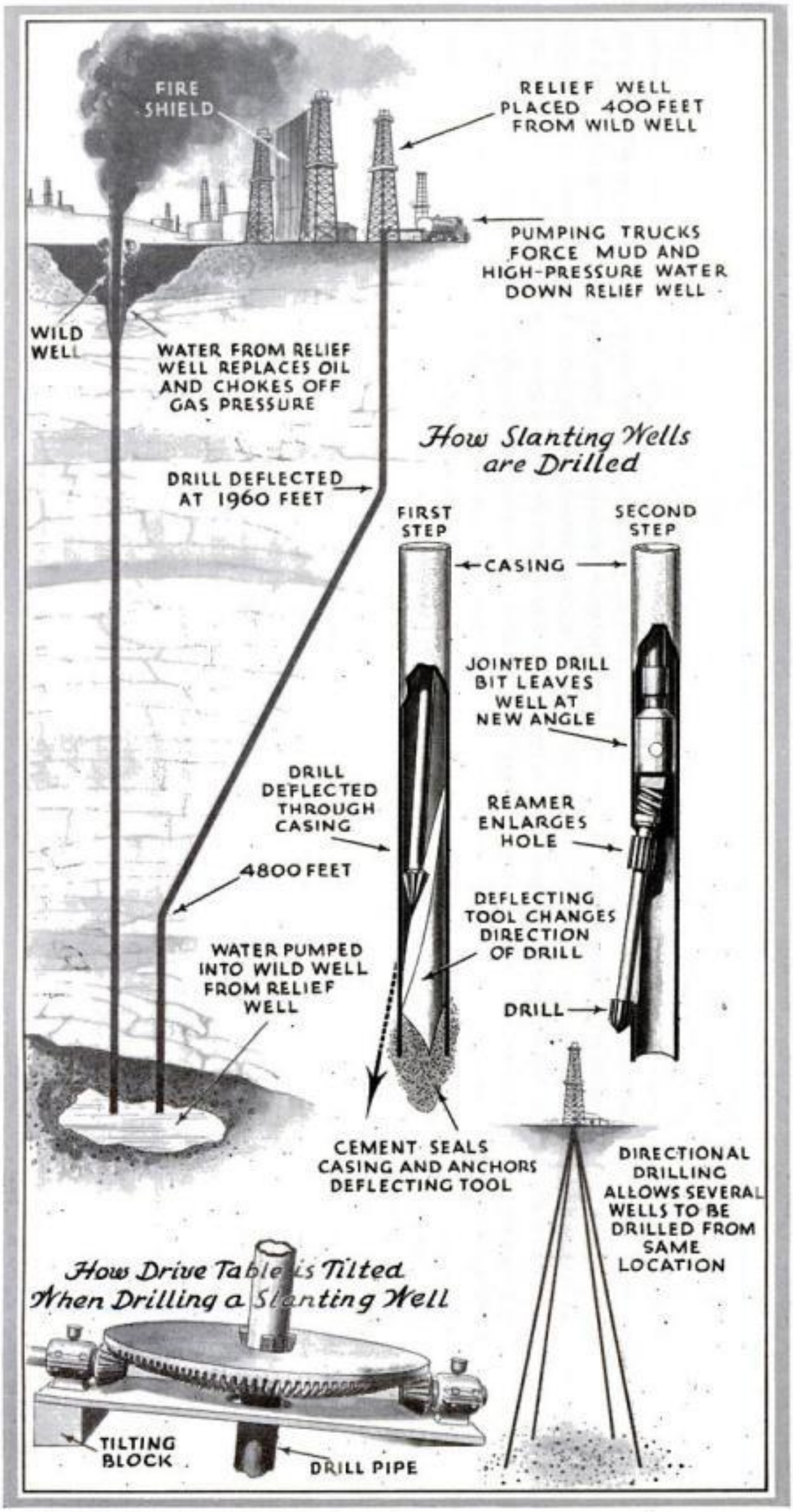
What to do with this valuable elephant? Company experts had no feasible scheme. From Long Beach, Calif., they summoned H. John Eastman, directional drilling expert, who proposed a daring plan. He would start a new well near the crater, and by the use of mechanical deflectors, would throw it within a 100-foot circle drawn around the bottom of the runaway well. Then mud or water could be pumped in to choke the gas pressure and shut off the flow of oil.

It seemed a wild venture, but it was the only hope. The Humble Company placed an expert crew of drillers at

MEASURING THE SLANT OF A WELL AS IT IS DRILLED

In circle, camera that makes records of film showing the inclination of well being dug. Right, whipstock that is set at bottom of well to deflect bit. Left, acid-etched bottle that shows slant of the well

Work New Marvels



NEW TOOLS USED IN SLANTING WELLS. In center above is whipstock, cut-away to show how it deflects bit. At its right is the universal joint used to follow hole on new slant. Above is tilting turntable that can be set at any angle. Upper left, well that stopped runaway

Eastman's disposal with orders to follow his instructions.

In the toolhouse of Alexander No. 1, he found the record of an old acid-bottle survey, made when the well was being drilled. The hole was almost perfectly vertical. With the aid of simple geometry, Eastman sketched a plan. He would sink a straight hole part way, then drift sidewise in an arc, intersecting the oil formation close to the wild well.

Four hundred feet from the crater, Eastman started his relief well. To guard against fire, a huge, sheet-iron shield was built between the well and the crater. Foam generators were set up on all sides, with nozzles trained upon the crater.

When the drill reached the depth of 1,960 feet, it was pulled up, and down into the hole went another instrument. Below its cutting teeth was attached a piece of pipe cut diagonally along its length, on a slant. Drillers carefully lowered it until it fitted the bottom of the hole. Then the bit was set in motion. Following the slanting surface of the beveled pipe, it was deflected, starting a new hole at an angle toward the runaway well.

Twenty feet more, and the deflecting tool was removed. Into the hole went a single-shot surveying instrument of Eastman's own invention. As it hit bottom, a miniature camera within the instrument clicked, photographing the position of a compass needle and a spirit-level bubble. Twenty minutes later, Eastman was reading the position of the hole from this record. It checked exactly with his plan.

Into the hole now went a universal-jointed bit, which readily followed the new slant that had been established Every 100 feet, another survey was made, to be sure the bit was drifting in the right direction.

Dexterous control brought the hole along a curve to the depth of 4,800 feet, where the required drift was obtained. Again Eastman caused the bit to swerve like a live thing, plunging straight down to 5,135 feet. Here, at last, it struck the oil formation.

The drill was pulled up, casing set in place, and a battery of powerful pumps began to force water down under tremendous pressure. For a time the well seemed to resist the flow. Suddenly something gave way, and the fluid began to run rapidly into the ground. It had broken its way into the subterranean cavern whence oil had been removed by the wild well that was still active.

Within a few hours, the flood of oil ceased spouting from the crater. Eastman's relief well had done its work.

The crater could now be drained, the lost Christmas tree raised, and the well restored to orderly production.

Strangely, the new science of slant drilling originated through science's efforts to drill oil wells straighter. Wells used to wander far from *(Continued on page 117)*

By means of cover-glass drawing attachment and transparent millimeter scale, you can find the magnifying power of your microscope. First measure a small object under low power. Then use this measurement to calibrate other higher magnifications

STRANGE PLANTS *you can see* In Microscope Gardens

In circle, highly magnified yeast plant which plays an important part in industry. Below, planting one form of micro-garden. A yeast tablet is being dropped into small glass of molasses water

Photomicrographic view of dust-garden bacteria that cling together in little clusters. They can be seen at 100 diameters when stained. At a higher power, the individual bacteria will become plainly visible

By MORTON C. WALLING

RAISING prize roses or chrysanthemums gives no greater thrill than that experienced by the amateur microscopist who establishes a micro garden. This wonderland is a covered dish; the soil is a specially prepared gelatin or agar, and the seeds are tiny bits of living dust that are floating in the air of your home, in theaters, and almost everywhere. It costs but a few cents to establish several dust gardens.

A petri dish is ideal for your garden, but you can use a saucer or other shallow dish covered with a plate of glass. The dish and cover must be sterilized well before planting. You can do this by placing them in a cold oven, raising the temperature gradually to a point where white paper will be scorched, and keeping it there for a half-hour; or you can steam them in a kitchen cooker for two or three hours. The idea is to kill all of the little plants that may be adhering to the dish and cover. When the process is complete, remove the dish and cover, and let them cool. Then you are ready to add the sterilized soil.

The soil, consisting of nutrient agar or gelatin, can be purchased ready-made at drug stores that sell laboratory supplies. It comes sealed in tubes, and is simply added to the dish, diluted, if necessary, with sterilized water. However, you will find it a simple matter to make your own soil from easily obtained material.

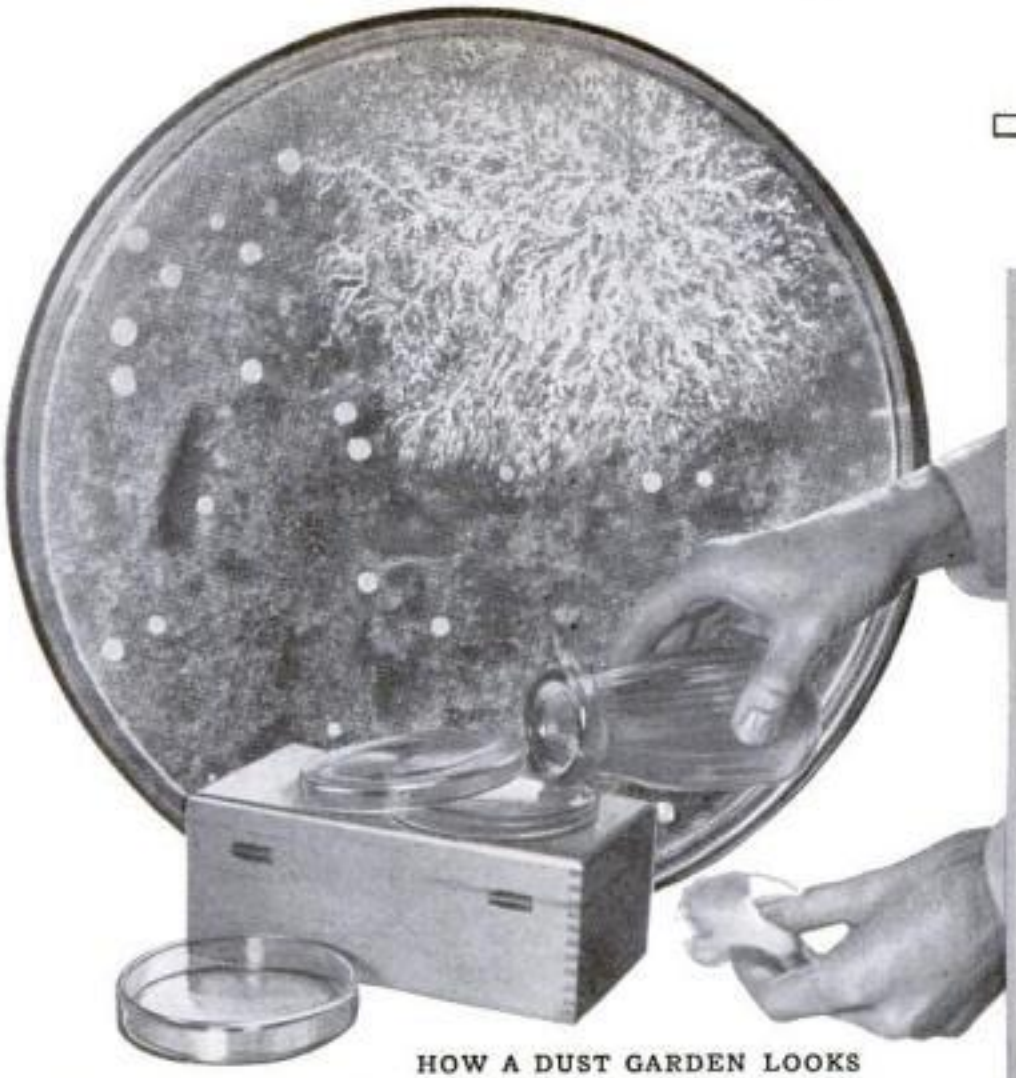
Obtain a quarter-pound of beefsteak and chop it into small pieces. Pour a cup of cold water over it, and bring slowly to a boil. Cook for about fifteen minutes. Add about one-fifth teaspoonful of baking soda (sodium bicarbonate) to the broth.

You can use either granulated gelatin or agar, a seaweed preparation, to give body to the soil. Place three tablespoonfuls of either the gelatin or agar in a cup and moisten with water. Then add this to the beef broth and boil for several minutes, until all of the gelatin or agar is dissolved. Remove the mixture from the fire and filter it through absorbent cotton or several thicknesses of wet flannel or other cloth. Pour into a pint milk bottle or similar container, previously heated to prevent breakage. Cork the bottle with a wad of cotton.

Although it is not likely that there will be many living microscopic seeds in the soil, it is best to make sure there are none. To do this place the bottle of nutrient gelatin or agar after cooling for a day, in a pan of cold water, using enough water to come within an inch of the top, and bring to a boil. Continue boiling for thirty minutes. A piece of cloth beneath the bottle is recommended, to keep the glass from direct contact with the bottom of the water container.

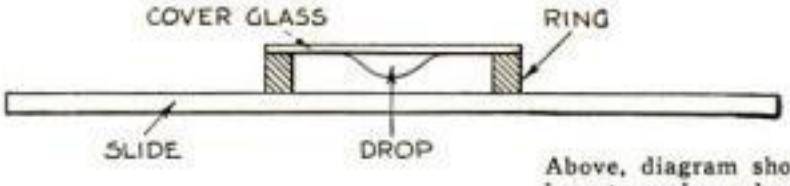
When the soil has cooled to a point where the container can be held in the fingers, lift the cover from one of the sterilized dishes, remove the cotton cork from the bottle, and quickly pour into the dish enough of the mixture to form a thin layer. Let it harden. Your micro garden now is ready for planting.

This planting process consists merely of placing the dish in a room and letting it remain uncovered for fifteen to thirty minutes. If the room has been swept with a broom a few minutes before the dish is exposed, you need leave the cover off for only two or three minutes. It is interesting to take a dish to a theater and uncover it for several minutes, and later determine what kinds of living



HOW A DUST GARDEN LOOKS

Above, sterile beef broth and agar are poured into a petri dish to make a dust garden. In circle, a microscopic view of a dust garden four days after planting. Note, growth of mold and bacteria groups



Above, diagram showing how to make a hanging drop cell so you can see inside the water. Below, the cover-glass drawing attachment that is used in finding the power of your microscope's lens

Left, one way of transfering dust-garden specimens to a slide. The smear is dried, washed in alcohol and drained. A match is touched to the remaining alcohol film while slide rests with specimen side uppermost

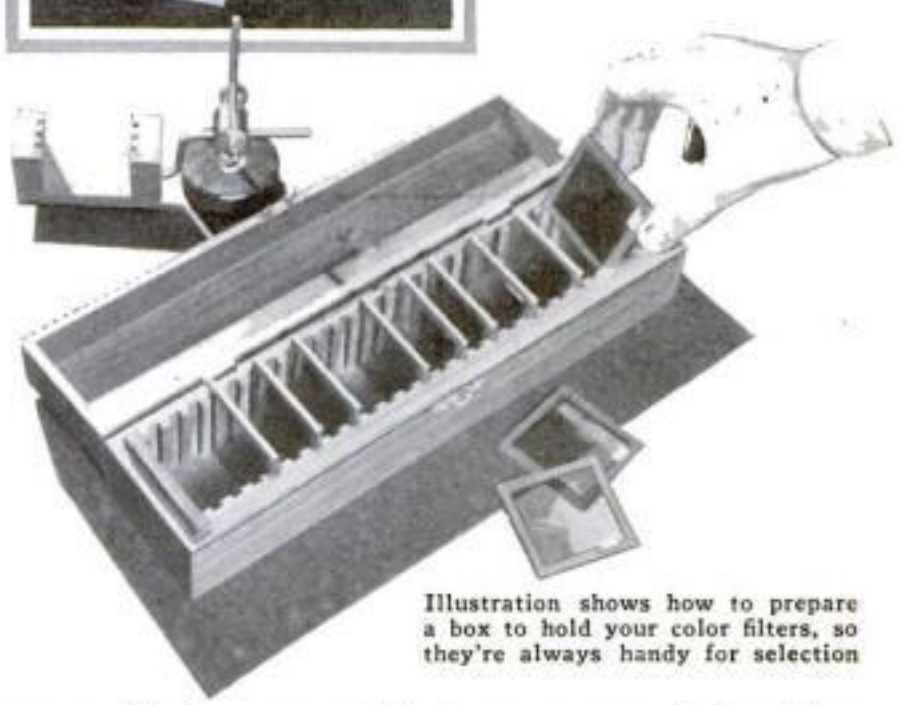


Illustration shows how to prepare a box to hold your color filters, so they're always handy for selection

things found in the playhouse atmosphere.

Set the freshly planted garden in a warm place. A day later, you ought to detect one or more spots made up of irregular filaments. These are molds. Another day, and you will find several small, shiny specks on the soil surface. Some are orange, some yellow, others white, and perhaps still others are ivory colored. These are colonies of bacteria. Each shiny spot started from a single germ that fell upon the soil from the atmosphere while the cover was off. You would have encountered difficulty finding and examining that single germ even with a high-powered microscope. But because the original seed found the soil of your micro garden nourishing and the temperature sufficiently warm, it started growing. Soon it had divided into two separate microbes. Then each of these had divided to form four. Then there were eight, sixteen, thirty-two, and so on until the colony became large enough for you to see, in spite of the great number that died.

EVEN if you had no microscope, you would find the micro-garden interesting. By planting gardens under various conditions, you can determine with fair accuracy just how germ-laden the atmosphere is. You can prove that the household broom is one of the least efficient of cleaning implements because it stirs up dust plants and causes them to fly about in the air and settle on food and dishes. It becomes obvious why food should be covered when left on the table. You can demonstrate that the dust stirred up by a broom requires two hours or so to settle, so that dusting of furniture should be delayed as long as possible after sweeping; and that a dampened broom or dust cloth is less offending than a dry one.

These microscopic plants generally are harmless under normal conditions. You inhale bacteria and mold spores with every breath, and think nothing of it. However, you may capture an occasional disease germ in your micro garden. For that reason, you must exercise care in handling the colonies. Do not touch them with your fingers. When you are through with your investigations, place the garden, slides, cover glasses, instruments, and whatever else came in contact with the bacteria, in water and boil for at least two hours. The water should contain washing soda, about a tablespoonful to the gallon. This process kills the plants and renders harmless those which already were not that way.

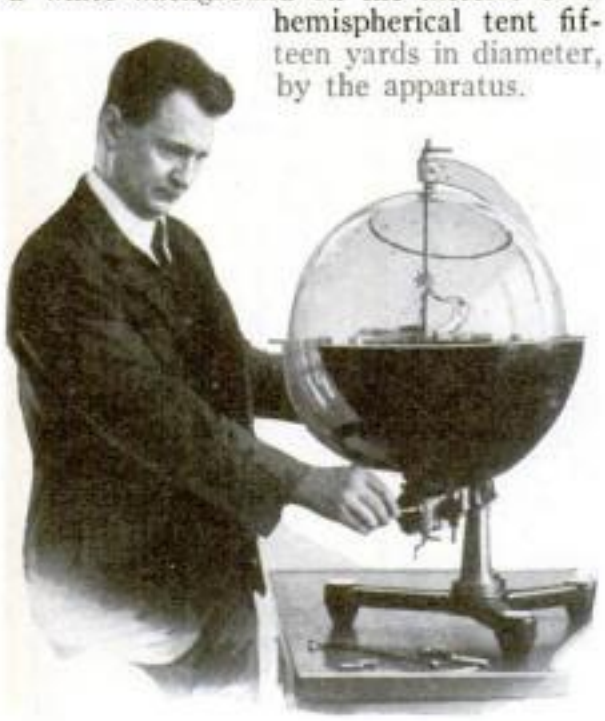
Perhaps you have thought it would be usless for you to try to see bacteria with your microscope. Such a thing, however, is entirely possible and easy, if you have an instrument that magnifies 300 to 500 diameters, as many amateur microscopes do. Some of the round, shiny, yellow plant beds in your micro garden probably are composed of bacteria which go by the musical name of Sarcina lutea. These micro-organisms look for all the world like tiny, cube-shaped Christmas packages tied with string. That is because, in reproducing, they divide in three dimensions and the individuals hang together in groups.

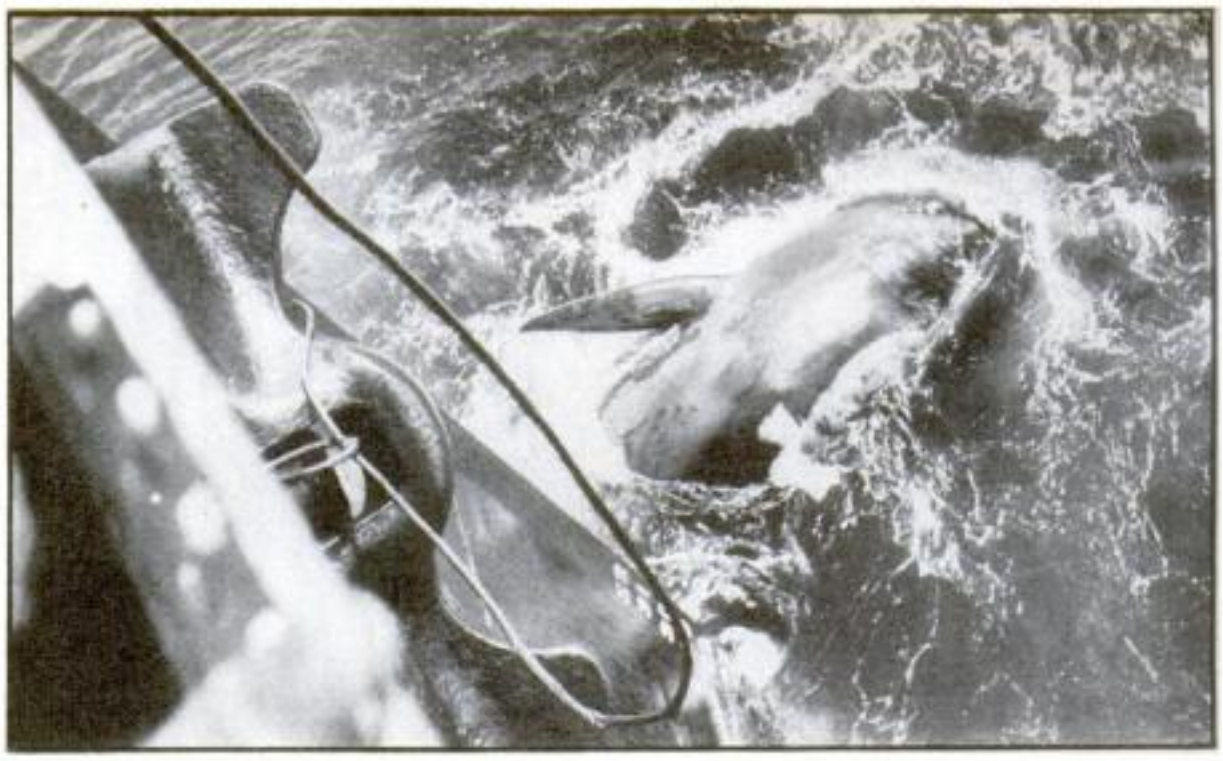
One way of observing S. lutea is to arrange a hanging drop. With the point of a dissecting needle, remove a speck of the material that composes one of the yellowish spots in your dust garden and mix it with a drop of water previously placed on a clean cover glass. Invert this cover glass over a slide that has a fairly thick ring of glass or other material cemented to it. The cover glass should rest on the ring, so that the drop of bacteria-laden water hangs down in the little well formed by the ring. You now can focus your lens on a thin layer of the water, where it adheres to the cover glass.

Another way of observing the bacteria is to stain and mount them. Clean a slide and cover glass with soap and water and dry with an old linen handkerchief. Then pass the glass pieces several times through an alcohol or gas flame to remove all traces of grease. Do not hold the cover glass in the flame long enough to warp it. Put a drop of water on the cover glass or the slide and stir in, with the needle, some of the bacteria mass. Do not add too large a speck of the organisms. Dry the specimen, using a *(Continued on page 104)*

STAR MOVEMENTS SHOWN IN TINY PLANETARIUM

INVENTED by a German school teacher, a miniature planetarium designed for use in high schools and colleges is said to reveal the movements of celestial objects as clearly as the large models. Stars and planets are shown as black spots against a white background on the interior of a hemispherical tent fifteen yards in diameter, by the apparatus.



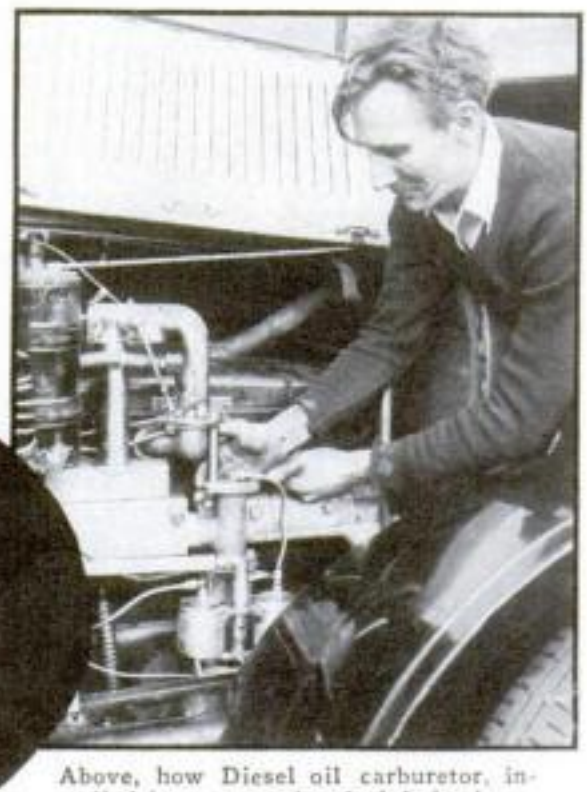


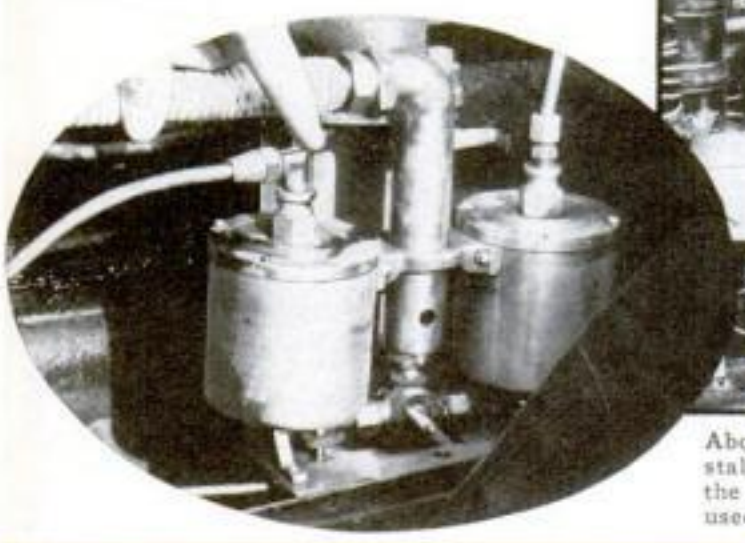
SHIP HITS WHALE AS CAMERA SNAPS

RARELY does a collision between a ship and a whale occur but more rarely still is a photographer on hand to snap as striking a picture of such an accident as the remarkable view reproduced above. Passengers aboard the New York-bound liner *President Taft* thought the ship had hit a rock when the whale was struck, at a spot about 1,000 miles northwest of Balboa. The stunned whale remained afloat.

CALIFORNIAN RUNS HIS CAR WITH DIESEL OIL

A DUAL carburetion and vacuum system enables George L. Moore, of Los Angeles, to drive his car using Diesel oil as fuel. Under the new system, the car is started with gasoline and run until it warms up. Then the Diesel carburetor is switched on. The heat is raised to only 170 degrees for Diesel oil to ignite. The Diesel oil is preheated by a pipe attached to the motor.





Above, how Diesel oil carburetor, installed in auto, works. At left is shown the gasoline and oil carburetors that are used in Diesel oil burning machine

Three-foot model of a steam tow boat demonstrates its power by pulling a twenty-six-foot boat with two persons in it. A quarter horsepower engine runs the miniature tug

No need to stoop with this lawn cutter

GRASS CUTTER LOOKS LIKE A GOLF CLUB

RESEMBLING a golf club, a long-handled cutter for trimming grass and mowing down weeds has just been placed on the market. It is said to be more efficient than an ordinary sickle and saves kneeling down to cut the weeds.

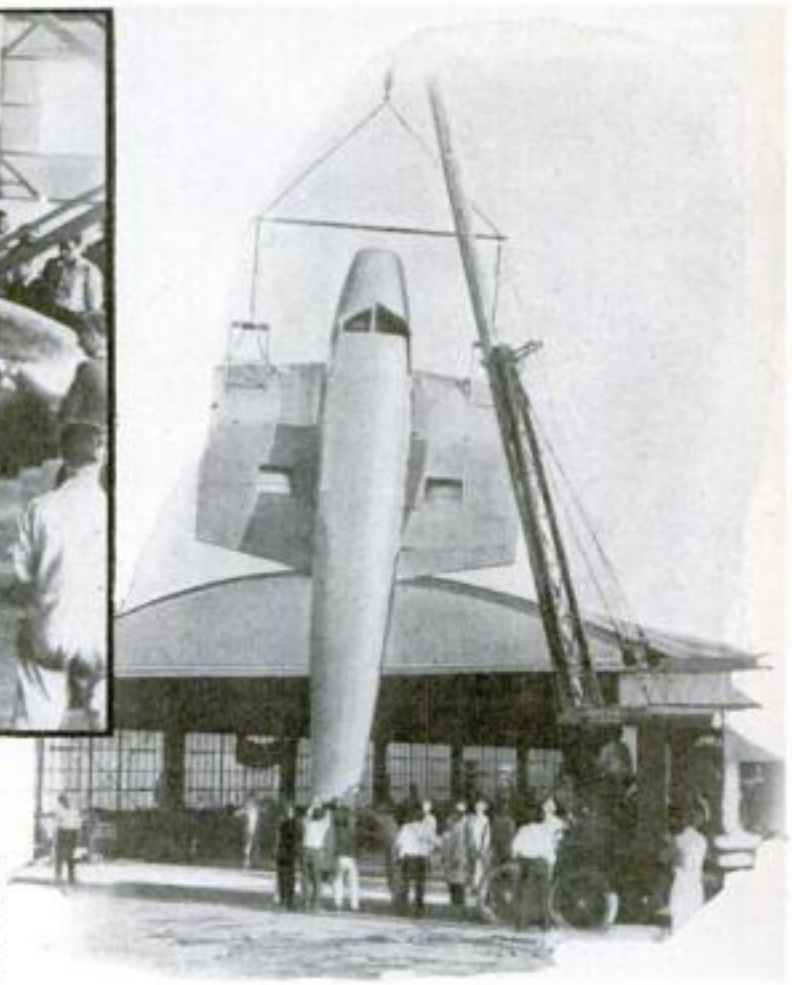
THREE-FOOT TOW BOAT PULLS 26-FOOT PUNT

TO DEMONSTRATE the power of a model of a Liverpool steam tow boat, its British builder attached the tiny vessel to a twenty-six-foot punt. With two persons aboard, the punt was towed at the surprising speed of four miles an hour. The miniature tug is three feet long and is fitted with a steam engine that develops one-fourth horsepower.

Plane's Wings Support Thirteen Tons of Sand

Sacks of sand weighing thirteen tons were piled on the wings of this plane. They bent five inches but snapped back at once when weight was removed

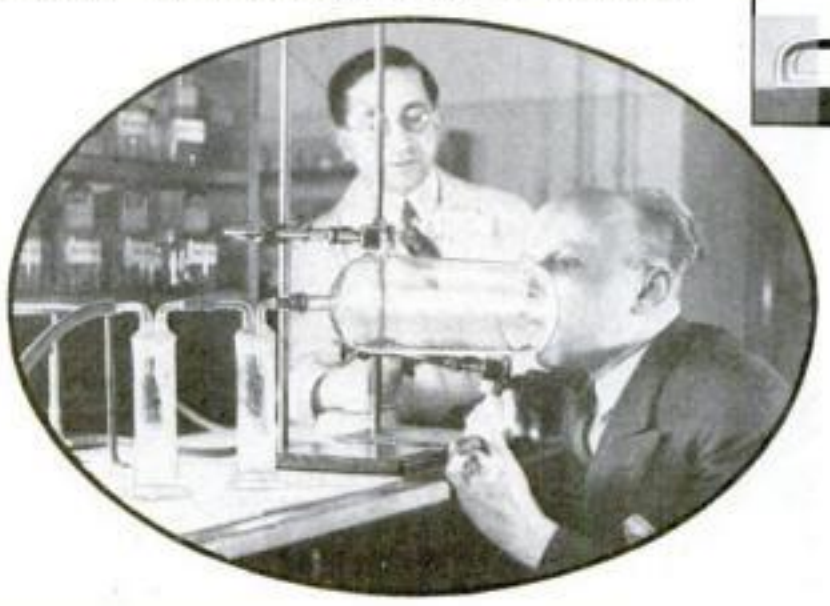
EIGHTEEN tons of lead and sand gave a new all-metal transport plane a spectacular test the other day at a Burbank, Calif., factory. After a huge crane had turned the fuselage upside down, the wings were attached and loaded with sacks weighing thirteen tons, while additional weights were placed on the engine mounts. The wings bent only five inches and returned to normal position as soon as the weights were removed, satisfactorily demonstrating their tremendous strength.



Big crane turned plane over for weight-carrying test

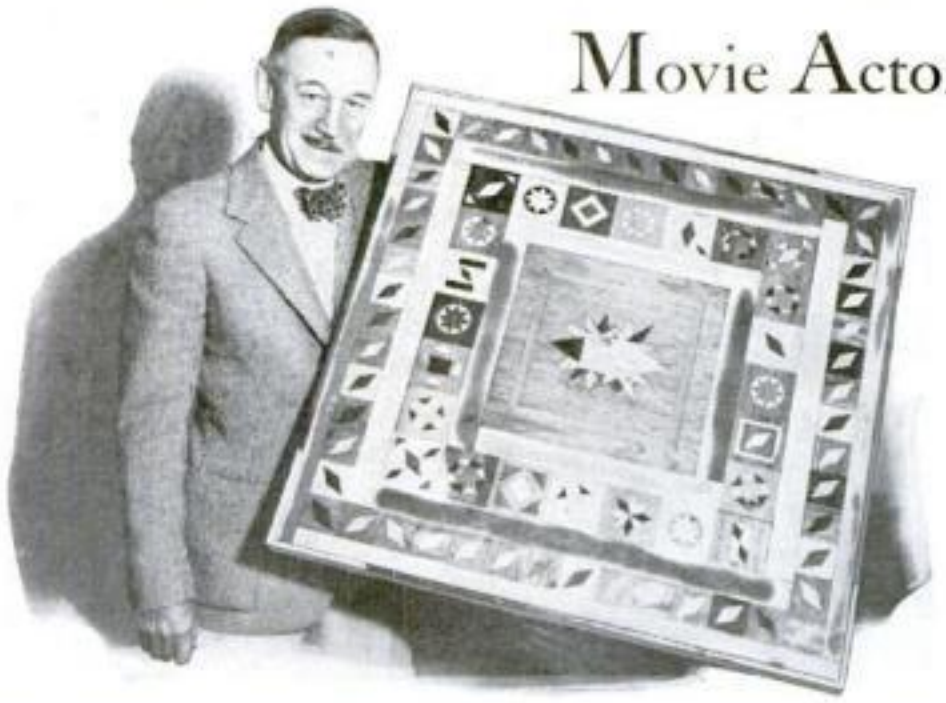
NICOTINE GIVES SMOKING ITS KICK

PEOPLE enjoy smoking because of the nicotine in tobacco. This is a fact just announced by Yale University physiologists. Their tests show that the nicotine, when inhaled, stimulates the adrenal glands and that these in turn release a little of the sugar normally stored up in the body for muscle fuel. Photograph shows how nicotine absorbed by a smoker is measured by comparing drug in his breath with that found in the cigar.



PENDULUM LEVEL MAKES ANGLE READINGS EASY

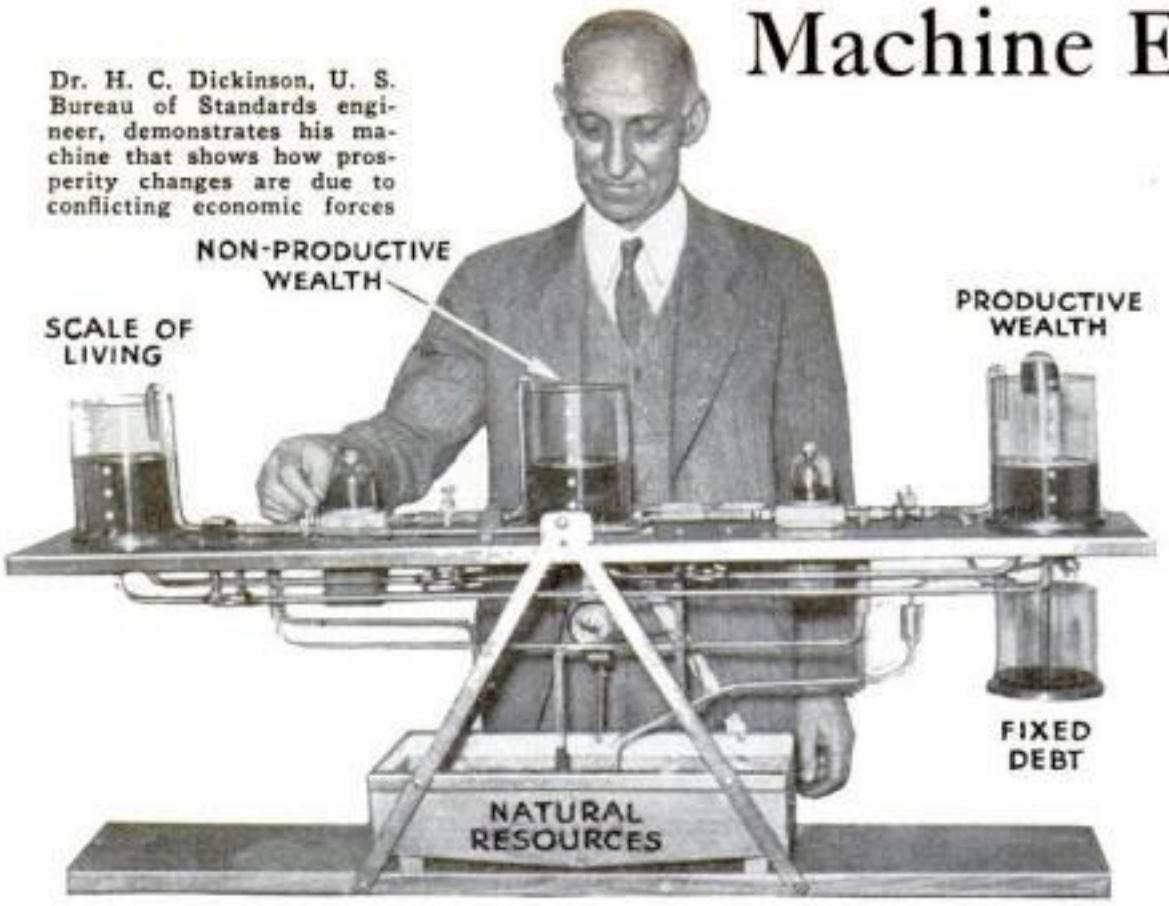
READINGS impossible with levels of ordinary design are said to be given instantly by a pendulum level invented by a Californian, and illustrated above. Its gravity dial shows at once the angle or slope of machine parts, plumbing, roads, or airplane rigging. One side of the dial gives degrees, and the other the slope in inches per foot. Angles can be read with the level upside down.



Movie Actor Works at Hobby on Lot

UNLIKE most amateur craftsmen, Charley Grapewin, veteran stage actor who entered the movies two years ago, takes his hobby to work with him. To while away the waiting time between camera shots on the set, Grapewin found it possible to carry on his favorite pastime of making decorative inlays for furniture, with the aid of a kit containing thin strips of wood, a penknife, and a bottle of glue. Supplementing in this way the time he can spare for the workshop in his own garage, the actor has filled his home and office with unusual inlaid objects. Chairs, tables, a desk for his office, and numerous cigarette boxes are among the pieces he has decorated. One of his most remarkable feats of handiwork is a card table containing 365 inlaid pieces, created in only four days on the movie lot.

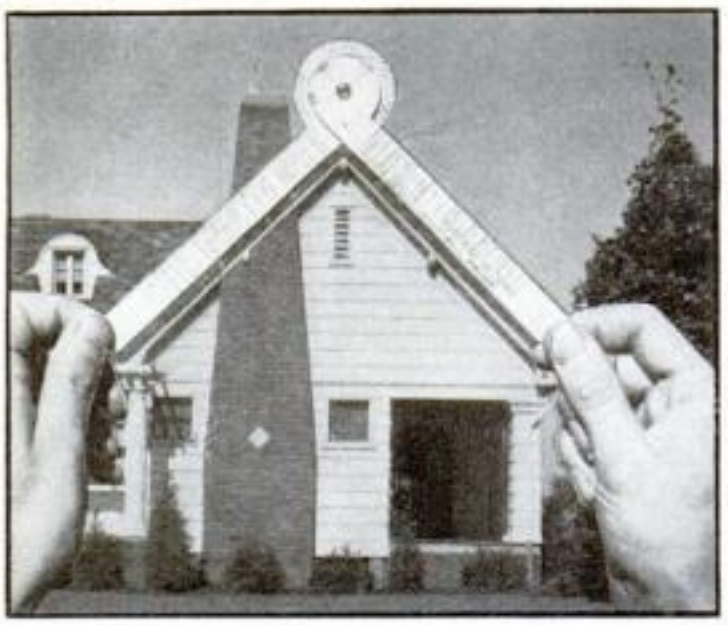
Machine Explains Business



Dr. H. C. Dickinson, U. S. Bureau of Standards engineer, demonstrates his machine that shows how prosperity changes are due to conflicting economic forces

To DEMONSTRATE the forces that bring about prosperity or depression, Dr. H. C. Dickinson, engineer connected with the U. S. Bureau of Standards, has devised a curious machine that he calls an "economstrator." With its aid, he declares, the entire economics of a nation's rise and fall can be explained graphically. Two tiny electric pumps circulate colored liquid through glass tubes, representing channels through which commodities change hands, and connecting sources of supply and consumption. When the flow is interrupted by closing valves at various significant points, the pivoted platform tilts, and the shifting liquid shows just how the whole economic system is thrown out of balance. This is done by measuring reservoirs that represent economic activities.

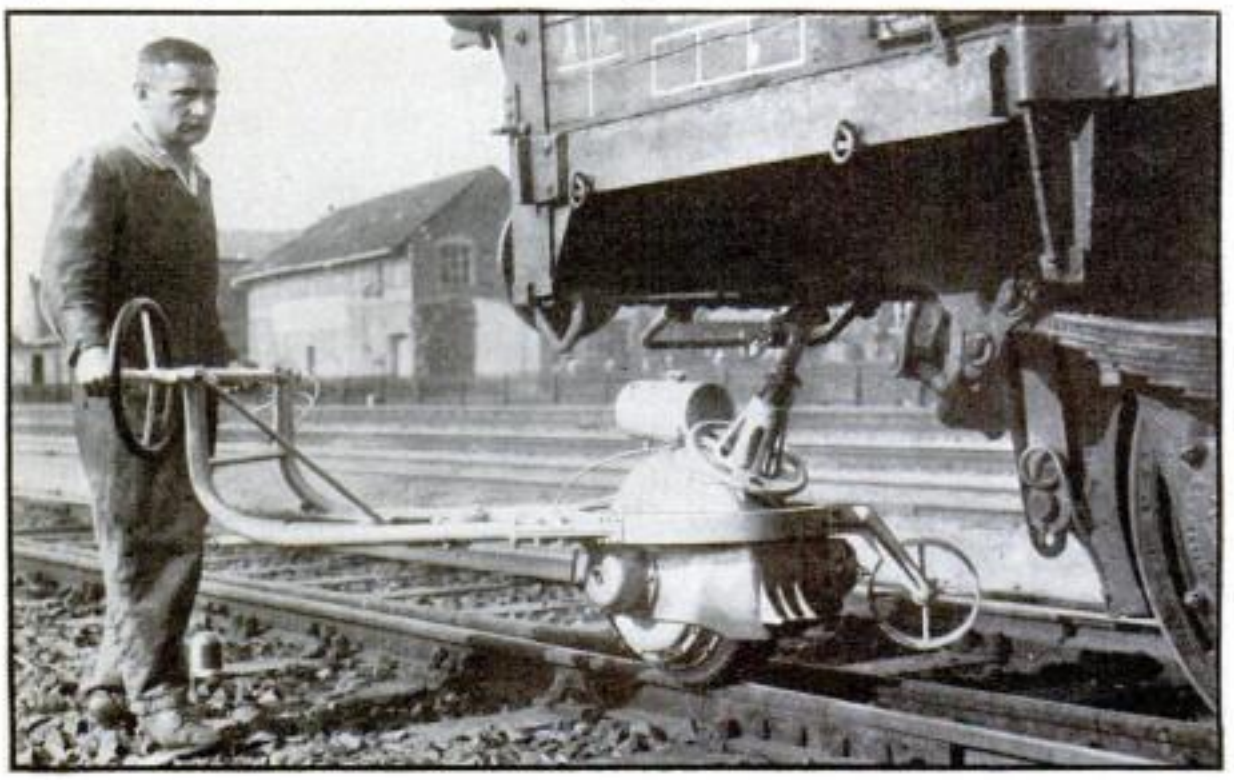
POCKET SCALE SHOWS PITCH OF ROOF

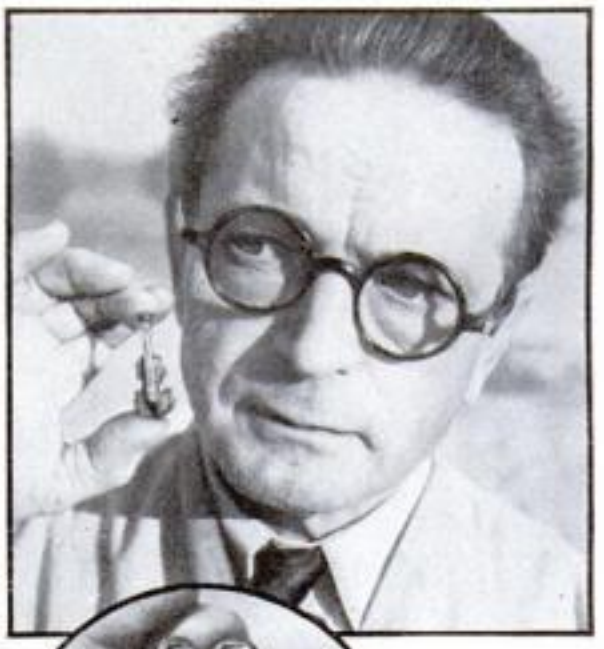


DESIGNED for architects, builders, and roofing contractors, a new pocket scale reveals at a glance the roof pitch of any structure and other information useful in estimating and construction. When the folding celluloid arms are aligned with the gable of a house or with a drawing or photograph of it, as at left, pointers on the scale indicate the angle in degrees and the rise in inches per foot run. A printed table shows the corresponding roof area, the required length of rafter, and the heel and plumb cut, which may be marked directly upon the rafter by using the scale as a protractor.

TINY GAS ENGINE MOVES FREIGHT CARS

WITH the aid of a tiny motor pusher developed in Germany, a single worker can roll a freight car to any desired spot on a siding, sparing the expense of operating a shunting locomotive. A six-horsepower gasoline motor runs the single drive wheel of this device, which rides along the rail on its rubber tire as illustrated below, pushing the car ahead of it. The pusher can also cross rails.





Above, Fassauer Ferron with the midget violin he made. It is perfect in all details. Left, an even tinier instrument made by Emmons C. Moulton. Note the bow and case

SCALE-MODEL VIOLINS SMALLEST IN WORLD

Two skilled violin makers of Pasadena, Calif., participated recently in an unusual contest to see which could produce the smallest and most nearly perfect miniature instrument. One of the friendly rivals, Fassauer Ferron, labored for five months. His product was a tiny carved violin of seasoned wood, one and three fourths inches long, weighing less than one thirty-second of an ounce, and complete with ebony keyboard and miniature strings and pegs. The other, Emmons C. Moulton, took a month longer to complete a scale model one and a half inches long, with maple back and neck, spruce top, and ebony trimming, fashioning the strings of horsehair.

PESTS WASTE BILLIONS

THE annual board bill of American insects is two billion dollars. This figure, according to experts of the U. S. Department of Agriculture, represents the value of produce eaten or destroyed every twelve months by insect pests in American farms and orchards.

...D LOOPS

SECURELY pivoted to it...OPE car gives thrill-seek... of looping the ...icroscope," a new of special instrument, no longer pow...case, can amplify faint sounds ...0,000 times. According to the in...ntor, the sound made by tearing apart two postage stamps, if amplified in this ratio, could be heard more than 350,000 miles away. The instrument will detect the boring of worms in dock piling or reveal the sounds of human joints to aid medical diagnosis.

Noise microscope in use to amplify tick of watch. It can increase noise 100,000,000 times

In circle, Hermann Grapow at work on his dictionary of Egyptian characters. Above, a page of data used in preparing the work. Right, some of the dictionary's many handwritten volumes

WORLD'S STRANGE DICTIONARY HAS OVER 100 VOLUMES

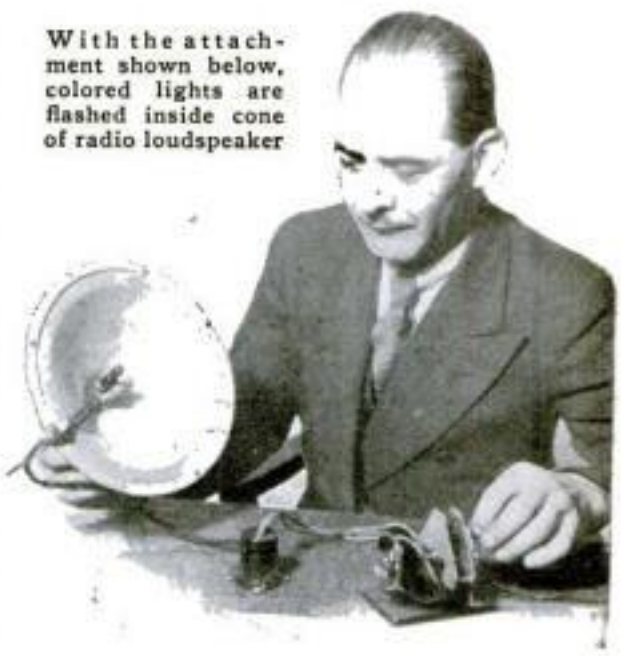
WITH its hundredth volume just finished, in handwritten form, the world's strangest dictionary is still progressing toward completion. This monumental work will be the first systematic dictionary of Egyptian hieroglyphics, and students of Egyptology have labored for more than forty years under the direction of Prof. Hermann Grapow, noted German expert, to prepare it. Its pages will permit a speedy translation of the ancient inscriptions found on tombs and pyramids. Indexing labels on the volumes present a curious appearance, since pictorial characters must be used.

In England clock dials are set beside the road to warn drivers when lights must be turned on

CLOCKS WARN MOTORISTS TO TURN ON HEADLIGHTS

SO THAT motorists will have no excuse for delaying, past the proper time, the lighting of their head lamps, special clock-dial signs are being installed at intervals along country roads in England. The signs bear the legend, "Lighting-Up Time Tonight," and the clock hands are adjusted daily to show at just what minute the legal period of grace after sundown ends.

With the attachment shown below, colored lights are flashed inside cone of radio loudspeaker

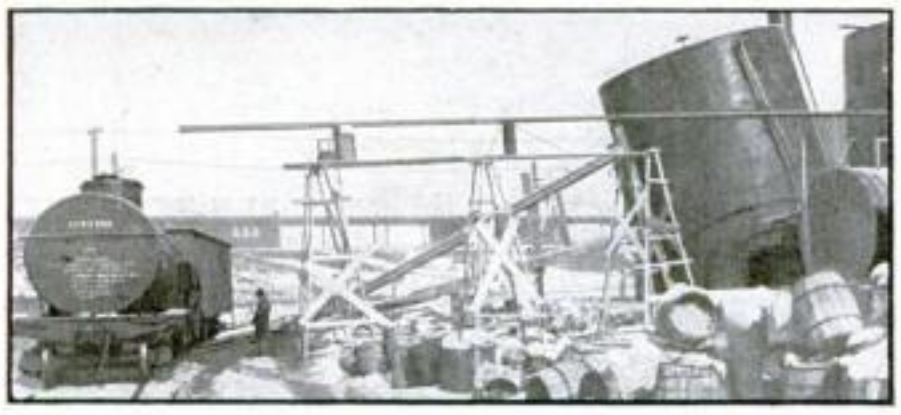


COLORED LIGHTS FLASH WHILE RADIO IS ON

TO ADD to the enjoyment of a musical selection heard on the radio, a Brooklyn, N. Y., inventor has designed a loudspeaker attachment that flashes a succession of colored lights during the program. Four miniature colored bulbs are mounted inside the cone, and are lit in turn by a rotating switch driven by an electric clock.

FREIGHT CARS ANCHOR TILTING TANK

FREIGHT cars, serving as anchors for a large tallow storage tank, recently prevented a costly upset at an eastern plant. When the tank was filled for the first time, it tilted sideways on imperfect foundations. To save it from toppling, workmen threw up timber braces set against a nearby railway track. Meanwhile two heavy freight cars were rushed into the position shown and kept the track from shifting until the tank could be emptied and its foundations repaired.



Simple Stunts with Balls and Shadows Show

HOW THE Sun *and* Moon ARE Eclipsed

In the illustration above, a lamp globe represents the sun, and a golf ball, the moon. A piece of curved cardboard is the earth's surface. The arrangement shows why the shadow cast by the moon upon the earth has a darker center called the umbra and is surrounded by a lighter ring called the penumbra. At right, diagram shows why all the sun's rays are cut off within the umbra during a total eclipse, and only part of them are intercepted within the penumbra

IF IT were not for a strange coincidence, nobody on earth would ever have seen a total eclipse of the sun!

This famous and awesome phenomenon, the blotting out of the entire sun in full daylight, is due solely to the accidental fact that the sun is 400 times broader than the moon, and about 400 times farther away. These facts make possible a total eclipse of the sun.

Because of the remarkable coincidence of size and distance, the sun and moon fill the same angle at the observer's eye; or, in other words, they appear to be the same size to one on the earth.

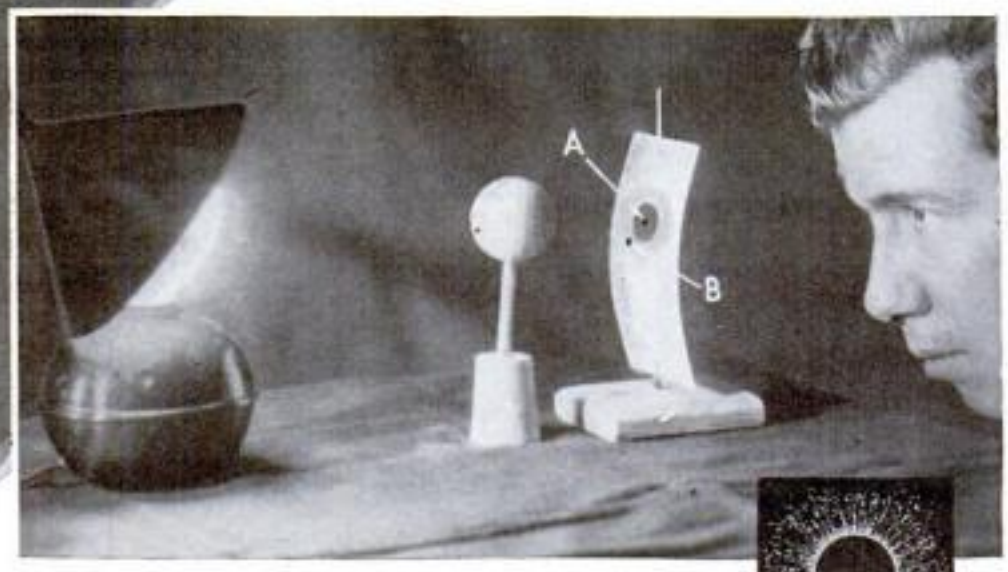
The moon is roughly 2,000 miles in diameter; the sun is approximately 400 times as wide, or over 800,000 miles. The moon is about 240,000 miles from the earth. If the sun were exactly 400 times farther, it would be about 96,000,000 miles. As a matter of fact it is around 93,000,000 miles.

What a surprising coincidence of distances and sizes, causing the sun and moon to occupy the same angle in the eye of an observer on earth!

In a previous article we found that if a one-half-inch division on our bow-rule was held fifty-seven times its length (twenty-eight and one-half inches) away from the eye, the one-half inch occupied an angle of one degree. (P. S. M., June, '33, p. 42). Accordingly, a one-fourth-inch division on the rule would represent the one-half-degree angle occupied by the sun or moon.

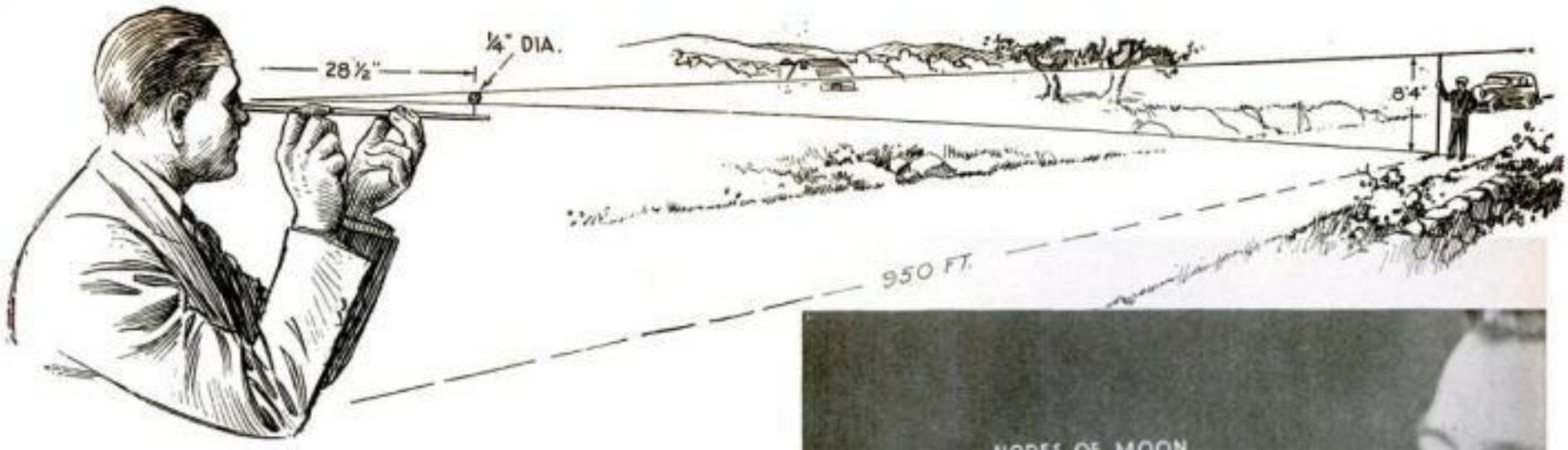
Here is a simple experiment you can try which will give you a better idea than an ordinary diagram could of why the sun and moon occupy the same angle at the observer's eye.

Put a one-fourth-inch green pea on a toothpick, and insert the other end of the toothpick in a little hole near the end of a dowel rod. The rod is twenty-eight and one-half inches long. This will allow you to rest its end on your cheek bone while



AREA OF TOTAL ECLIPSE IS NARROW

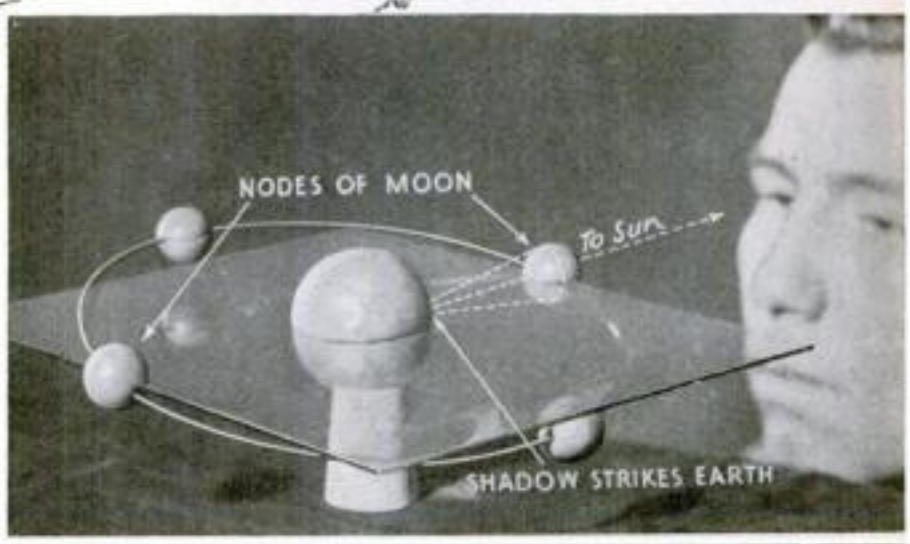
In a piece of cardboard representing the earth's surface holes A and B are made. Hole A is in the totally eclipsed area called the umbra, while B is in the partially illuminated ring called penumbra. Looking through A the lamp is completely hidden by the golf ball as shown in the upper diagram at right. When you look through B a portion of the lamp can be seen. This experiment shows why totality in a solar eclipse is restricted to a narrow path, while partial darkness during an eclipse covers a much wider area on earth

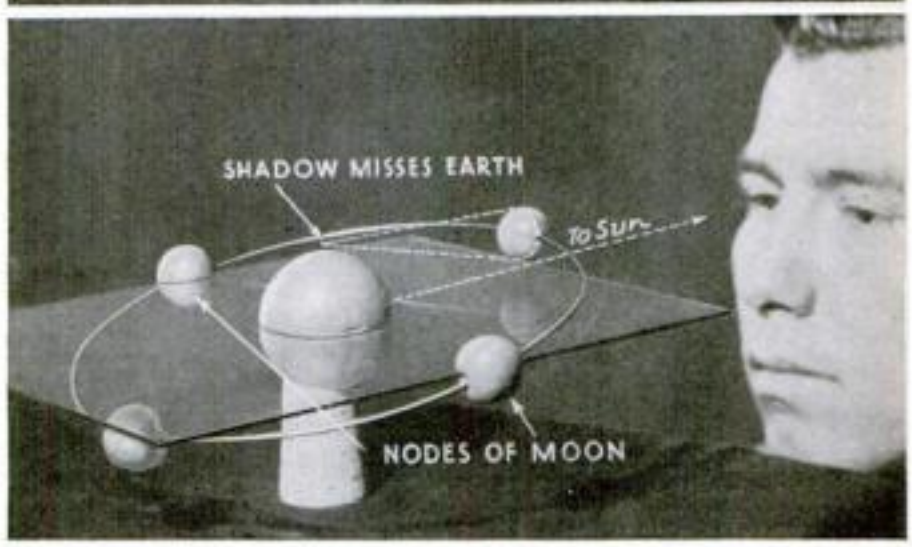


The experiment above shows why the sun, which is both 400 times wider and 400 times farther away than the moon, appears to us to be the same size as the moon. A quarter-inch pea is placed twenty-eight and a half inches from the eye. It then occupies one half a degree. A stick eight feet, four inches long, placed 950 feet from the eye also occupies half a degree. The length of the stick and its distance from the eye are 400 times the size and distance of the pea, exactly as the sun is to the moon

By

GAYLORD JOHNSON



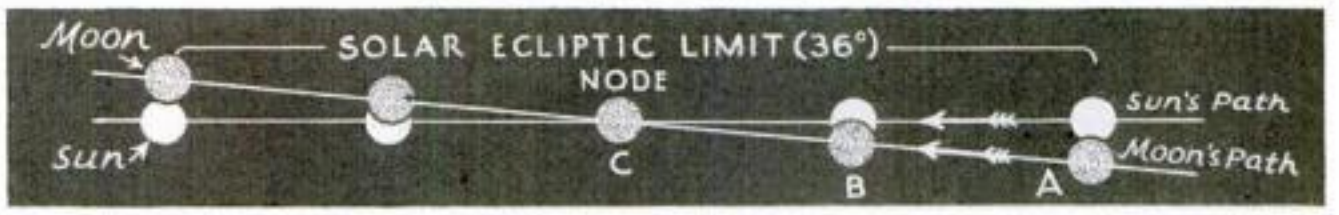


The two illustrations at the right show why total eclipses of the sun are rare. The ring of wire, set at a slant to the pane of glass, illustrates how the moon's orbit is at a small angle to the plane of the earth's orbit. When the pane of glass is held level with the eye and rotated slowly it becomes evident why total eclipses seldom occur. The moon is in the plane of the earth and sun at only two points, its nodes, and it is only when the moon is at a node that it can get in line with both the sun and the earth and cause its shadow to touch the earth, as is seen in the upper illustration. At all other points, the moon casts its shadow too high or too low, as is clearly seen in lower view

you look past the pea on the toothpick. The quarter-inch pea will then be 114 times its diameter away from the eye, and occupy an angle of half a degree at the eye, just as the moon does.

If you want to prove it, look at the moon with this piece of apparatus some night. You will find that the pea just eclipses the moon when you get them exactly in line with your eye.

Now for the rest of the experiment. If the quarter-inch pea on the stick represents the moon (2,000 miles in diameter) and the twenty-eight and one-half inch dowel rod represents the distance from an observer on the earth to the moon, (240,000 miles) how far away must you place your sun in order to have it occupy the same angle at your eye as the pea does? And how large will the sun be?



In the illustration above, the reason for the greater frequency of partial eclipses of the sun is shown. This is due to the fact that there is a considerable area on each side of a node where a partial eclipse of the sun can occur. At any point within eighteen degrees of one of the moon's nodes a partial eclipse is possible. When a new moon occurs at A, the sun is not obscured, but when the new moon gets between the earth and sun, as at B, a partial eclipse occurs. A new moon at C gives a total eclipse, but it is seldom the moon is new at this particular point

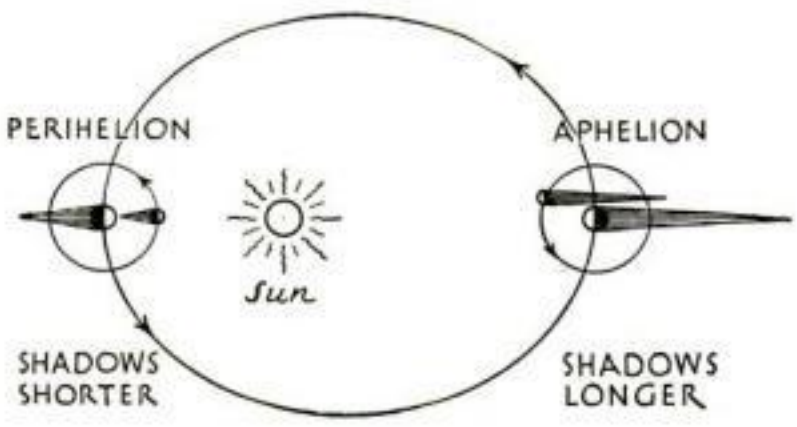
The answers are given when you multiply the pea's distance (twenty-eight and one-half inches) by 400, and its diameter (one-fourth inch) also by 400. The sun will be 100 inches in diameter or eight feet four inches. The distance at which a stick eight feet four inches high is just covered by a quarter-inch pea (held twenty-eight and one-half inches from the eye) is 950 feet, or about two tenths of a mile. If you want to try the experiment, get a friend to take the stick in a car, run off two tenths on the speedometer, and then hold the stick vertically on the road while you "eclipse" the stick with the pea which is resting on your eight-foot stick.

This experiment also enables you to visualize the proportions of the slender cone of shadow which the moon constantly casts into space. It is about in the proportion of one-quarter inch to twenty-eight and one-half inches.

It is the narrow, pointed end of this shadow cone which travels across the earth's surface, and causes the path of totality during a total eclipse of the sun. The thickness of the shadow cone where the earth's surface cuts it is seldom over 100 miles, while at its moon end it is 2,000 miles in thickness, being cast, of course, by the moon's entire diameter.

This experiment has prepared us to understand the meaning of two terms which always occur in eclipse descriptions—the umbra and the penumbra. In plain English these mean "the shadow," and the "next to the shadow."

Both are demonstrated clearly in the experiment shown in the illustrations. The large electric bulb with the reflector represents the sun. The golf ball on a stick represents the moon. The circle where the shadow cone is cut by the surface of the card encloses the dark area of totality, the *(Continued on page 112)*



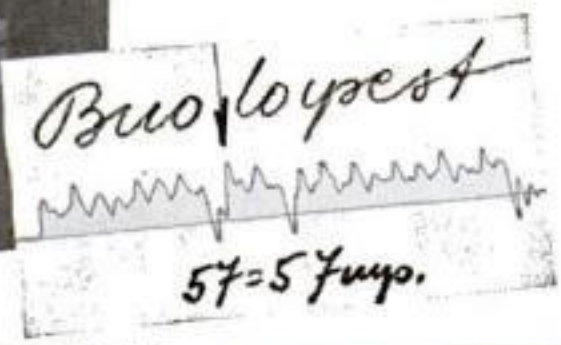
WHEN THE MOON'S SHADOW IS SHORTENED

The ellipse at the left represents the earth's orbit. The sun is shown slightly off the center. When the earth and moon are nearest the sun, as shown, the moon's conical shadow is shortened by one sixtieth, but when they are farthest from the sun, as shown at right side of the ellipse, the moon's shadow is one sixtieth longer than at other times

Test Handwriting as Indication of Character

With the aid of a new electrical pencil, the handwriting of a schoolboy is being analyzed to see if traits of character show in penmanship

Is YOUR handwriting a reliable index of your character and temperament? With the aid of a new device, known as an electric pencil, psychologists are trying to settle this question scientifically in a laboratory at Budapest, Hungary. When a subject grasps the pencil and writes, a curve is simultaneously registered upon an automatic recorder. The speed of the writing is shown by the total length of the curve, and the height of each loop above a base line measures in grams the force used, while the number of impulses used in setting down a word is shown by the frequency with which the line is crossed. Thus the curve provides a precise analysis of the handwriting.



At left, specimen of analyzed handwriting. The wavy curves show the writing to be energetic. Height of loops above base line indicates the pressure used

CONTROL TOWER AT DAM RESEMBLES BATTLESHIP

MASTS, turrets, and portholes may be discerned by an imaginative eye in the odd structure pictured above, which from a distance bears a striking resemblance to a battleship. Actually it serves as the main control tower for the great North Sea dam at Ymuiden, Holland. The modernistic lines of the building contribute to the optical illusion it produces.

MACHINE SPREADS GAS TO KILL GRAPE PESTS

LEAF hoppers that attack grape vines are being destroyed in California vineyards with the aid of an unusual machine resembling a pair of tents on wheels. As the tractor-driven machine crawls along between the rows, poisonous cyanide gas is blown into the tent-shaped chambers, which are open at front and back. Each plant gets an exposure of several seconds, which is sufficient to kill the insect pests. Perched on an elevated seat, the operator of the machine is not exposed to the deadly gas, which is heavier than air and clings to the ground.

MECHANICAL BRICKLAYER SPEEDS WORK OF MASON

ONE man can lay three times his usual quota of bricks in a day, it is reported, with the aid of a machine for the purpose that has been introduced in England. The mechanical bricklayer takes the place of a hand trowel, serving both as a container and an applicator for mortar. When a crank is turned, the device automatically advances, spreading a coat of mortar.

PLAN WEATHER REPORTS FOR TOURING AUTOISTS

STORM warnings for automobiles making cross-country trips form a possibility for the near future. Rex Martin, assistant director of aeronautics of the Department of Commerce, recently suggested to radio manufacturers that sets equipped to receive weather reports at frequencies of between 200 and 400 kilocycles would be of value to motorists making long trips. They would enable them to pick up the weather reports without stopping.

Turning the crank of this brick-laying machine advances it and spreads an even coat of mortar

Resembling two tents on wheels, this machine is drawn by a tractor between the rows of grape vines to spread poisonous cyanide gas. In this way destructive pests are easily exterminated

KNOCK-DOWN KENNEL EASILY ASSEMBLED

A knock-down metal kennel, with removable wood floor, is easily assembled

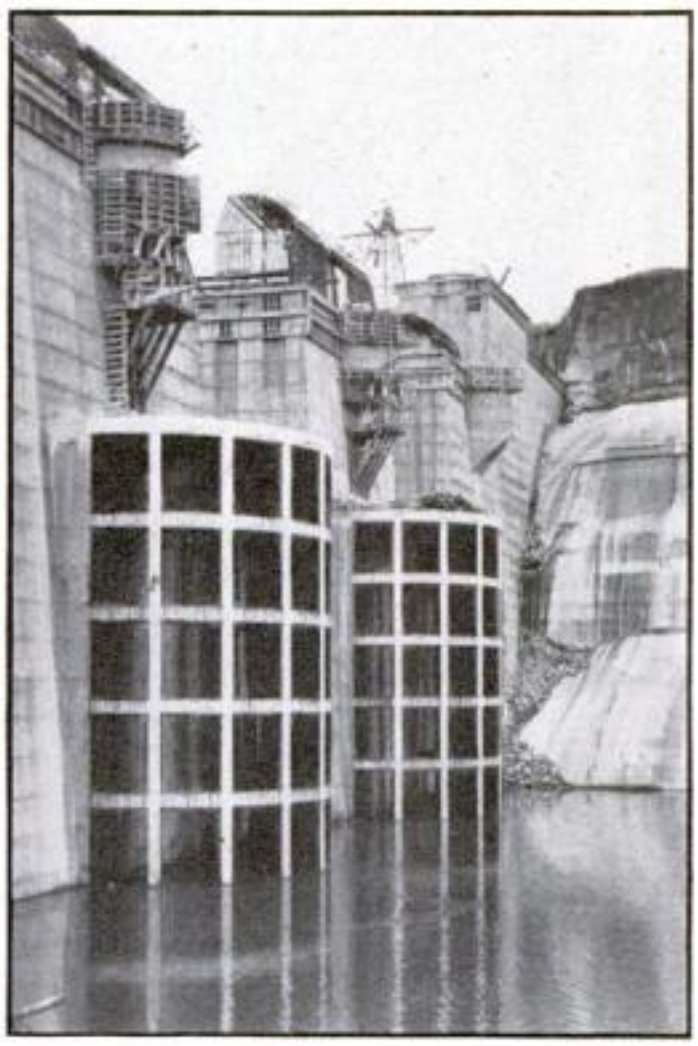
ANY dog lover may build his pet a home, using only a screw driver and pliers for tools, with a knock-down kit recently introduced for the purpose. All-steel material is provided for the sides and roof of the kennel, which are insulated to keep the interior warm in winter and cool in summer. The wood floor is removable for easy cleaning. Ventilation is provided for at the top of the kennel. At the front is a strong eyebolt for attaching the dog's rope or chain, while its name may be painted upon a nameplate over the doorway as seen in photo above.

USE LIGHT AND SUCTION TO TRAP TOBACCO PEST

SHAPED like the horn of an old-fashioned phonograph, an odd suction trap has been developed by entomologists of the U. S. Department of Agriculture to aid in exterminating beetles that feed on cured tobacco in storage warehouses. The trap, they say, will catch millions of the cigarette beetles in a single season, attracting the insects by means of a low-power electric lamp bulb at the mouth of the horn. The beetles, lured this far, are caught in the power suction of a twelve-inch fan, and are drawn irresistibly through a screen-wire trap into a glass jar.

NEW BULLET FOR SMALL RIFLE CUTS CLEAN HOLE

SPOTTING and scoring are made more nearly accurate by a .22-caliber cartridge recently introduced for indoor target shooting. The new cartridge, of a type hitherto available only in larger calibers, produces a clean hole that appears to have been cut from the target with a paper punch. The accompanying view shows the marked difference in design from the standard conical type. Part of its length is of reduced diameter, but the part that takes the rifling is long enough to form a tight seal for the powder gas.



These big gratings on dam being built in Panama, will protect its powerful turbines from floating weeds

FLASH LIGHT FURNISHES FLOOD OR SPOTLIGHT

A FLASH light that gives either a concentrated beam or a flood of light is the invention of J. H. Kurlander, Westinghouse Lamp Company engineer. A tiny cylinder of translucent material is attached to a telescopic mechanism in the battery case, so that it can slide over the lamp bulb. When a button projecting from the case is pushed forward, the cylinder intercepts direct rays between the bulb and reflector, producing a flood of light. Moving the control button back permits the reflector to function.

GRILL WORK GUARDS DAM'S TURBINES

TO KEEP its turbines from being choked by tropical weeds, the great Madden Dam now rising at Alhajuela, Panama, is being equipped with weed traps. The odd protuberances, resembling bay windows, are made up of multiple panels of grating that strain floating debris from the water at the intakes. When completed, the dam will augment the water supply for operating the locks of the Panama Canal, and will also contribute hydroelectric power to supplement the present plant at Gatun Lake.

HUNT WEED POLLEN MILE ABOVE EARTH

HUNTING weed pollen 5,000 feet in the air was part of recent experiments made by Dr. E. L. MacQuiddy, assistant professor of medicine, University of Nebraska College of Medicine. His study of the heights to which the floating pollen is carried during the hay fever season was conducted at altitudes that ranged from three to five thousand feet.

Pressing a button gives flood light or spotlight

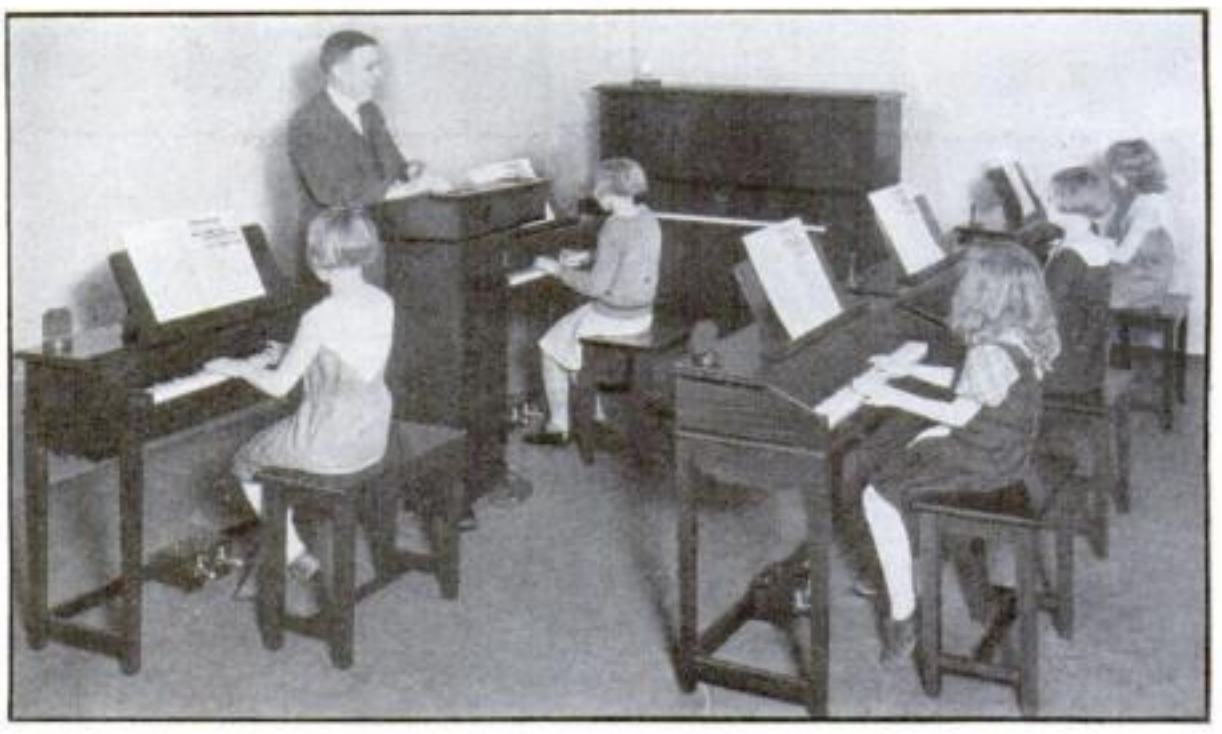
WINGS TURN BICYCLE INTO A GLIDER

With wings attached to this bicycle, the rider expects to use it as a soaring plane

SEEKING new thrills, a French bicyclist is experimenting with wings attached to the frame of his machine in the hope of soaring aloft. By gathering speed in a downhill run, he expects to be able to life the cycle from the earth and maneuver it after the fashion of a motorless glider. The photograph shows the designer trying out his winged bicycle in an initial test.

TINY AQUARIUM AIDS MICROSCOPE WORK

WATCHING the behavior of tiny plants and animals is made easier for the amateur microscopist by a live cell recently placed on the market which serves as a miniature aquarium. With the aid of a medicine dropper, liquids containing living creatures may be placed in the cell for observation under the lens.

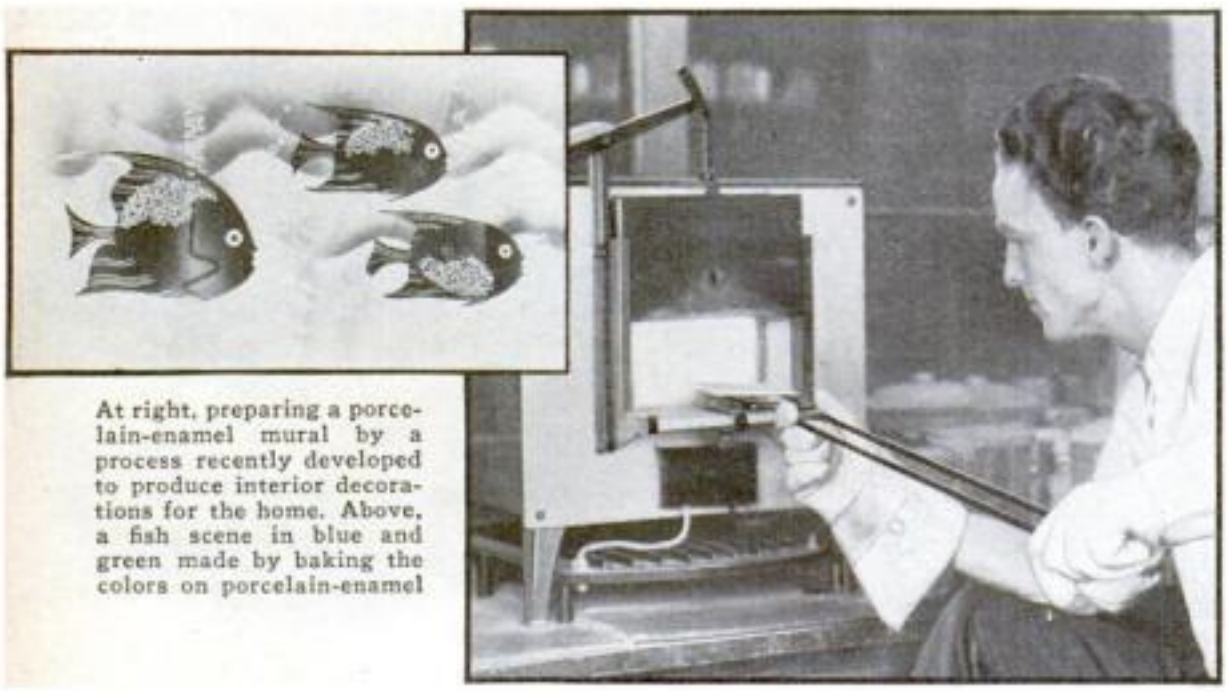


MANY CAN PLAY SAME PIANO AT ONCE

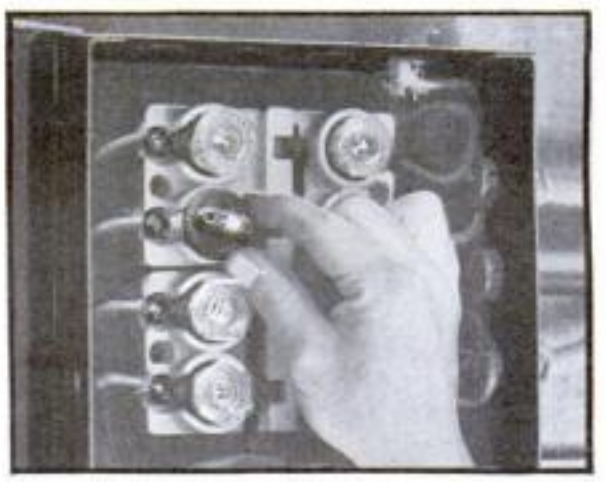
A MULTIPLE piano, just patented by R. W. Ross, of Mansfield, Pa., provides an innovation in piano instruction. When five or more pupils play on individual keyboards, as shown above, their notes are heard simultaneously upon a single electric piano connected to the keyboards by electric cables. By manipulating a control switch, however, the instructor can cut out all but one player at any time, in order to observe his individual performance and correct any faults. In this method, the students have the excitement of competition and the benefit of playing together.

ART WORK NOW MADE ON PORCELAIN

WHEN panels and shingles of porcelain enamel were used in the construction of the world's first "porcelain" house (P. S. M., November, '32, p. 44), H. Edward Winter, an artist of Cleveland, Ohio, saw the possibilities of the new material as an artistic medium. Working in the laboratory of the firm that built the house, he has recently developed richly colored murals of similar composition for interior decoration. After the enamel has been fused to its metal backing, the colors, applied through a stencil, are baked in, and the mural is then ready for hanging.



At right, preparing a porcelain-enamel mural by a process recently developed to produce interior decorations for the home. Above, a fish scene in blue and green made by baking the colors on porcelain-enamel

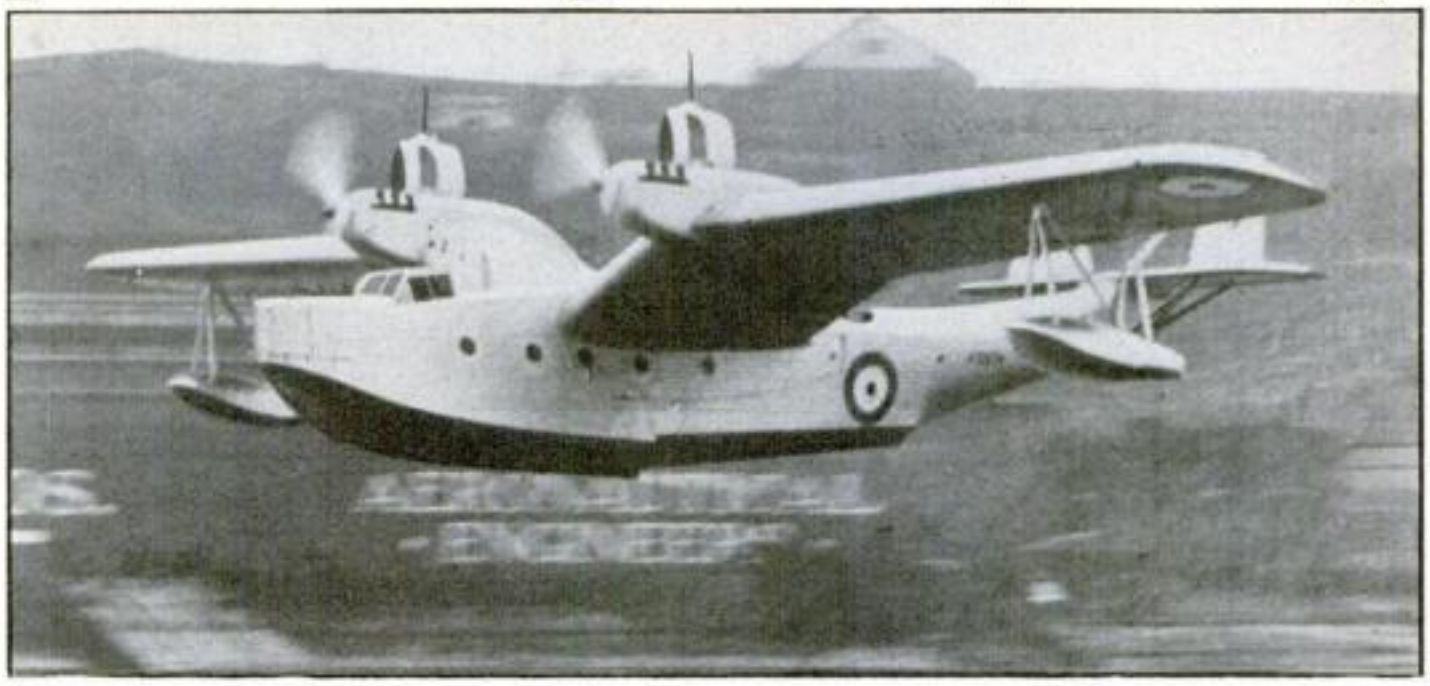


RED GLOW MARKS BURNT OUT FUSE

A FUSE that signals when it is burned out has just been placed on the market. This makes it unnecessary to grope about the fuse box for the plug that requires replacing. After its fusible element melts, a capsule of neon gas in the top emits a continuous red glow to attract attention. The detachable top may be used repeatedly, as the bottom half can be unscrewed and replaced with a special refill.

New Flying Boat Has Engine on Top of Wings

WINGS that arch diagonally upward from the fuselage give a new British flying boat the appearance of a sea gull about to alight on the water. Through this odd design, the engines, mounted atop the wings, are kept clear of spray in all but the worst weather. The big machine is a monoplane of sixty-foot wing spread, weighing more than eight tons when loaded, and propelled by twin engines. These power plants are provided with steam cooling system. From twin masts above the engines, wire strands lead out to serve as radio antennas.



Picture of England's new flying boat, with engines on top of wings, taken during its first tests

PLAN LIGHTS FOR ALL PARTS OF CAR

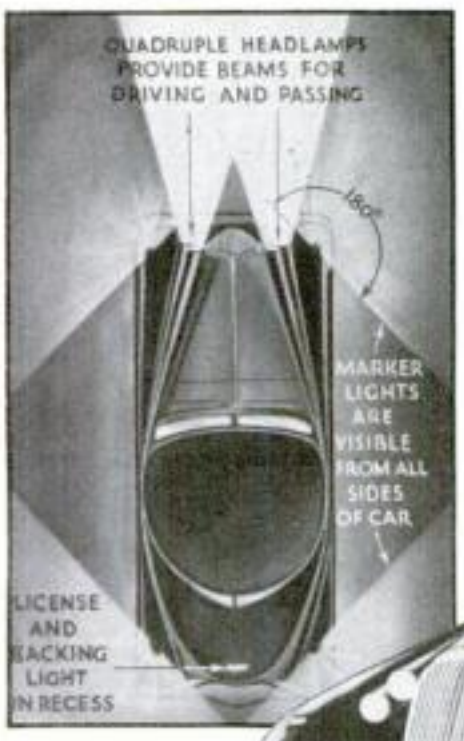


Illustration above, shows how new system of lighting increases visibility of car and so averts accidents

CARS of the future will be resplendent objects at night, if makers adopt an illuminating plan proposed by General Electric engineers for a well-lighted machine. Their recommendations include midget quadruple headlamps; marker lamps visible from all sides; a combination backing and license light; a luggage compartment lamp that lights when the lid is raised, and a dome light automatically switched on by opening a door. Indicator lights check on gasoline, water, oil, battery discharge, and stop light operation.

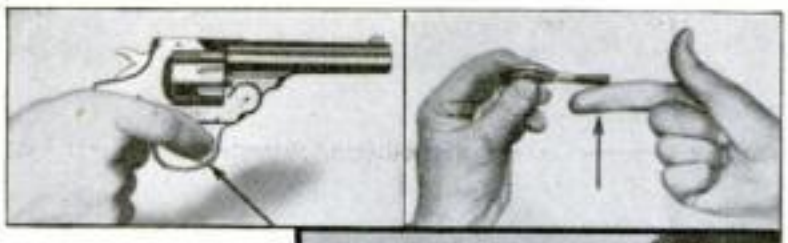
Exterior view of a car using lights that illuminate clearly every part of it

ELECTRICALLY POWERED CAMERA RUNS ITSELF

MORE complicated in appearance than the average movie machine, an electrically-powered still camera has been introduced in Hollywood, Calif. Permitting the camerman to give his entire attention to the subject, the camera automatically changes the film and registers the total number of pictures taken.

SPRING TRIGGER WORKS HYPODERMIC NEEDLE

INSERTED in a spring holder invented by a St. Paul, Minn., physician, a hypodermic needle gives a patient no uncomfortable prick when drugs are to be administered. The spring, released by a trigger beneath the doctor's first finger, propels the point so rapidly through the skin that there is no time for the patient to experience a real sensation of pain.



Above left, flecks of powder lodged in skin of finger when trigger is pulled. Above right, applying wax and chemicals so the powder can be seen.

At right, as the result of the chemical test, a blue ring appears as indicated by arrow

CHEMICALS TRAP MURDER SUSPECT

TELLTALE flecks of gunpowder, lodged in the skin, betray a shooting suspect through a modern method of scientific crime detection. To apply this delicate chemical test, a detective coats the trigger finger of a prisoner with warm mixture of wax, sulphuric acid, and diphenylamine crystals. If the suspect has recently fired a gun, a blue ring appears, caused by the reaction of the nitrate in the exploded powder with the chemicals.

Chemical Facts REVEALED BY HOUSEHOLD DRUGS

Epsom salts and milk of magnesia, two familiar household remedies, can be used to perform many experiments

Left, a lighted match held in the mouth of a flask from which steam is escaping is instantly extinguished. Above, burning magnesium ribbon held in the steam continues to burn by uniting with oxygen in the water

FROM a box of Epsom salts, the home experimenter can learn a great deal about chemistry. This everyday substance supplies a convenient way of studying the mysteries of the metal magnesium and its many compounds.

Chemically, Epsom salts are known as magnesium sulphate and can be labeled as such when transferred from the bathroom medicine cabinet to the amateur's laboratory shelf. Physically, the salts are a crystal-like substance whose water of crystallization causes it slowly to turn into a fine powder when exposed to the air.

Being particularly soluble in water, magnesium sulphate lends itself well to an interesting experiment in solutions—a demonstration of supersaturation. First, a strong solution of the chemical is made by dissolving it in boiling water. To free it of any impurities, the hot solution then should be filtered and allowed to cool undisturbed. At this point, the cooled solution should be shaken. In most cases, the liquid immediately will change into an almost solid mass of crystals.

When shaking fails to start the crystallization, the solution can be seeded with a small crystal of the solid magnesium sulphate. Usually adding this small amount of the chemical will start the growth, forming thousands of tiny crystals that will increase in size until the entire container is filled.

Should the experiment fail to work the first time, add more Epsom salts to the solution and boil it again. The solution must be supersaturated before the magnesium sulphate will start to crystalize.

If a warmed solution of strong Epsom salts is poured on a sheet of clean glass, similar crystals of magnesium sulphate will be formed as the liquid evaporates. Spreading mysteriously over the surface, the fan-shaped crystals will resemble the decorative frosting often applied commercially to glass. In fact, many old-time formula and recipe books suggest that window panes can be given a frosted effect by applying a strong solution of Epsom salts dissolved in beer. Undoubtedly, the beer was included to make the magnesium sulphate crystals adhere more firmly to the smooth surface of the glass.

A second household chemical, milk of magnesia, likewise forms an inexpensive basis for many interesting experiments with magnesium. In the language of the chemist, milk of magnesia is a solution of magnesium hydroxide. Being a base, it dissolves in weak acids to form magnesium salts. If added to hydrochloric acid, for instance, magnesium chloride is formed, while nitric acid combined with the chemical reacts to give magnesium nitrate.

This solubility of milk of magnesia in acids and its nontoxic properties make it a useful antidote for the treatment of acid poisoning. The magnesium hydroxide neutralizes the acid on the skin or in the stomach and forms the corresponding salt, which, in any case, is less injurious than the original acid.

In the home laboratory, you can prepare magnesium hydroxide simply by adding sodium hydroxide (lye water solution) to a solution of magnesium sulphate (Epsom salts). A white precipitate of magnesium hydroxide will be formed. To purify it, swirl the chemical around in water and then allow it to settle.

To test the remaining solution for the presence of the original chemical, add several drops of the sodium hydroxide solution to the clear liquid on top. If more precipitate forms, it is an indication that part of the original magnesium sulphate still remains. When this is the case, add more sodium hydroxide and again allow the precipitate to settle. This testing and adding should be repeated several times.

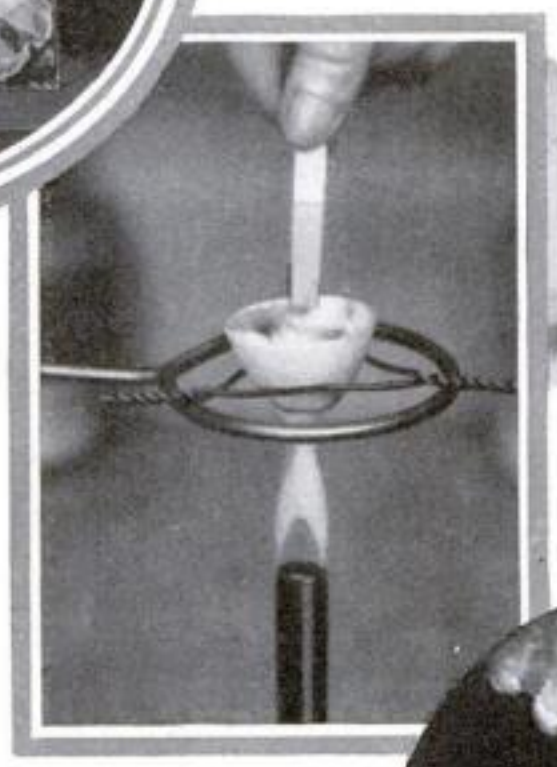
When no more of the magnesium sulphate is formed, the reaction is complete and the precipitate is ready for washing. To do this, carefully pour off the top liquid, which should be clear, add some fresh water, allow the precipitate to resettle, and again pour off the top liquid. After several washings, filter off the chemical. The magnesium hydroxide then can be dissolved in various acids to form any number of other valuable chemicals.

As in many cases where a clear top liquid must be poured off to leave a precipitate, you may find that the movement of the container stirs up the chemical that has settled out. By using the simple

Epsom Salts and Milk of Magnesia Furnish Material for Spectacular Experiments in Your Own Laboratory—How Brilliant Colors Are Formed with Melted Magnesium Chloride

A solution of Epsom salts is allowed to evaporate on a sheet of glass. Crystals like those seen above are formed in this way

Illustration shows a siphon arrangement that can be used to draw off top liquid without disturbing the precipitate. Blowing in the short tube will force the liquid out the long tube



To prove that hydrochloric-acid gas is released when magnesium chloride is heated, a piece of blue litmus paper, as above, is held in the fumes. At right, illustration shows how to obtain carbon dioxide from dry ice for magnesium test. The sand protects the bottle

Using a pestle and mortar, as above, magnesium ribbon and mercury can be forced to combine to form an amalgam

By RAYMOND B. WAILES

siphoning arrangement shown in the drawing, however, this difficulty can be overcome. Simply allow the chemical to settle and then blow into the short rubber tube as indicated. This will force the clear wash liquid out through the long exit tube without disturbing the precipitate.

By mixing some of the magnesium hydroxide with strong magnesium chloride solution and kneading the mixture into a paste, you can make a useful white cement or putty. When allowed to dry, the mixture sets to form a smooth, stone-like material. Many types of flooring materials and coatings are made in this way. When the substance is used as a putty for filling cracks, fine sawdust should be added.

With the aid of a gas burner, you can convert some of your prepared magnesium hydroxide into magnesium oxide, commonly known as magnesia. Place a small quantity of the magnesium hydroxide precipitate in a porcelain crucible or evaporating dish and heat it. After a time, your crucible will contain magnesium oxide instead of the original magnesium hydroxide.

The magnesia produced will be found to be particularly heat resistant and can be melted only under very high temperatures. Because it is a nonconductor of heat, this material has found wide use in the preparation of insulating materials for pipes. Chemically, it resembles ordinary lime (calcium oxide) since it combines with water to form a hydroxide.

Magnesium oxide also can be formed by burning the metal magnesium. Although this would be an expensive method of obtaining the chemical for laboratory use, it has the advantage of furnishing a spectacular experiment for the home chemist.

Magnesium metal is very light and almost white in color. It can be purchased either as a powder or in a thin ribbon. In the home laboratory, a small amount will form the basis of many thrilling experiments.

When sprinkled on an open flame, powdered magnesium burns with a vivid flash of white light and the illumination from a short length of magnesium ribbon will be equally intense. In fact, it is this quality of magnesium that makes it particularly valuable as a light source for indoor photography. Along this line, the home chemist can experiment with his own flashlight powders by mixing equal quantities of magnesium powder and powdered sodium chlorate. Place a small pinch of the mixture on a stone slab out of doors and ignite it by lighting a fuse made from a strip of magnesium ribbon. A brilliant flash will result. Because of the vividness of the flash, it is well not to look directly at the powder when it burns. Also, for safety, experiment with only a small quantity at a time.

When magnesium burns in air, a white powder results. This residue is magnesium oxide. Because of the oxygen that unites with it in burning, the magnesium oxide formed will be heavier than the original magnesium.

In our experiments with carbon dioxide (P. S. M., Aug. '32, p. 60), we found that the gas ordinarily does not support combustion but is in a sense an excellent fire extinguisher. Strange as it may seem, however, magnesium will burn quite readily in an atmosphere of the gas. You can demonstrate this by lowering a burning strip of magnesium ribbon into a jar of carbon dioxide gas. The combustion will continue just as it did in the air, the magnesium burning at the expense of the combined oxygen in the carbon dioxide. The carbon set free from the carbon dioxide will be visible as black specks or flakes on the inside of the container.

A simple way to obtain the carbon dioxide for this experiment is to place several lumps of dry ice in a glass bottle as shown. To eliminate any chance of the bottle cracking from the heat of the magnesium, pour in enough sand to form a layer on the bottom.

Under certain conditions, magnesium will decompose *(Continued on page 114)*

Household Inventions

RAZOR SHARPENER
Driven by a tiny electric motor, this new razor sharpener will strop and hone both edges of a safety razor blade at the same time. The device has chromium-plated housing

REFUSE ROOM IN WORK TABLE
Into the kitchen table seen at left, receptacles for refuse are built. Cans and bottles go down chute at right, while at left is container for the garbage

JACKET KEEPS LIQUIDS HOT OR COLD
Chilled beverages stay cold and hot ones hot when the bottle in which they are enclosed is covered with the thermal jacket shown at right. It is double walled and works on the principle of a vacuum bottle

SIGNALS MILKMAN
A bottle equipped with tabs, that can be arranged in various patterns, signals the milkman the amount of milk desired or the quantity of other dairy products needed. Device speeds delivery and saves the householder extra steps

TWIN CLEANING PAILS
Cleansing solution goes in one side of the pail shown below, and clean water for rinsing in the other side. Thus it is unnecessary to climb down for clean water to finish the job

MAGNIFYING MIRROR. Provided with a non-glare light a new mirror is designed to help women secure a good make-up. A small section magnifies the eyes and the lips

COFFEE MADE IN CUP. By making coffee in an individual cup, the time-saving device, at right, dispenses with the use of a percolator when small amount is needed

KNIFE SHARPENER
Set on a slant to each other, these two wheels revolve against the blade of a knife and quickly give it a lasting edge

OPENER PUNCHES TWO HOLES
A new-type can opener punches a big hole at the pouring edge of a can and a small air hole at the other edge so contents are instantly ready to pour

BEER COOLER. A thermos jug is converted into a beer cooler by putting on a specially designed top that is equipped with an air pump, a beer intake, and a spigot. The top fits containers from a half gallon to three gallons

CANDY MAKER'S THERMOMETER
Attached to the edge of the receptacle in which candy is being made, a dial-faced thermometer is clearly in view so temperature can be read at any time

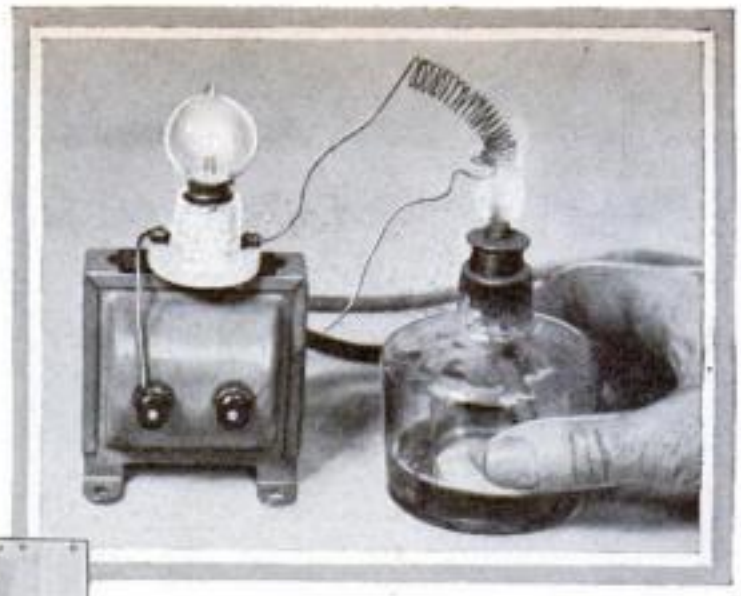
DOOR HAS KNOB IN WALL. Turning a knob built into one wall causes this sliding door to disappear into the opposite wall as shown

SIPHON FOR CARBONATED DRINKS. A pressure valve, housed within a metal cylinder that is pushed through the cap of a beverage bottle, acts as a siphon and releases the liquid under pressure

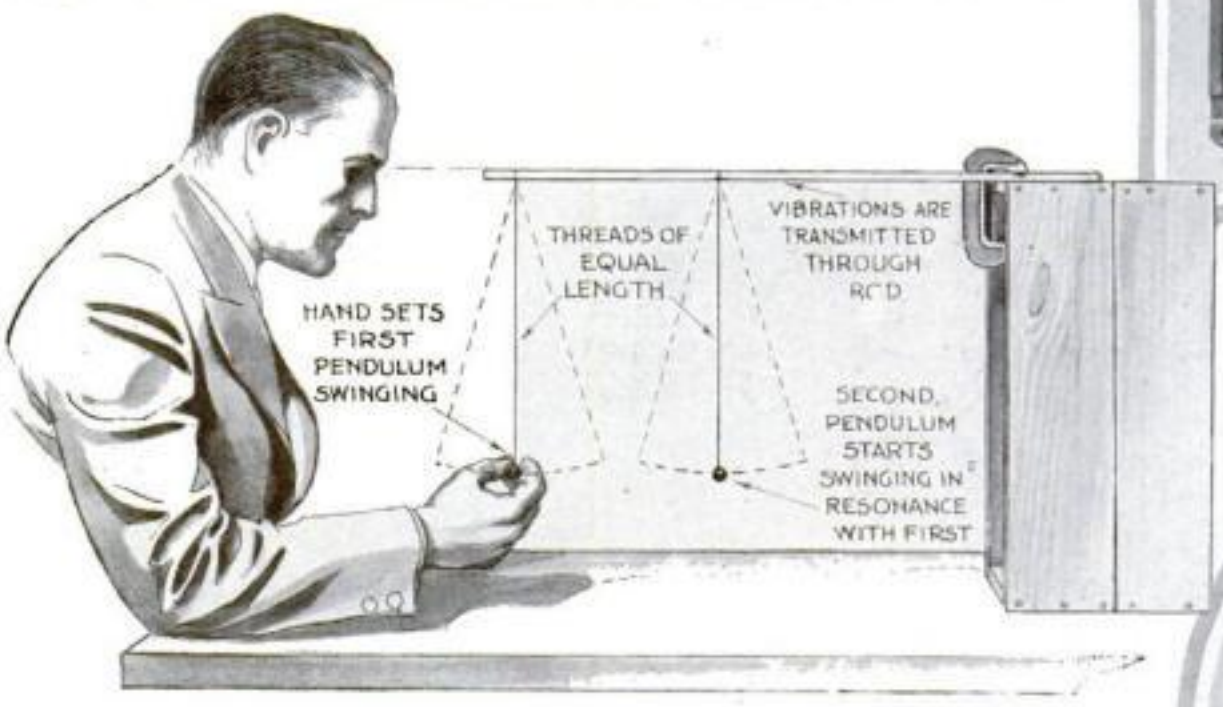
HANGER HOOKS TO DOOR TOP. An ingenious support that slips over the top of a closet door, as shown above, provides additional storage facilities without needing extra space within closet

AUTOMATIC TEAPOT
Requiring no attention after leaves have been placed in holder and hot water poured in, this teapot automatically brews tea. A timing cup measures the minutes and basket bobs up when the tea is properly brewed

Home Tests of
Scientific Laws

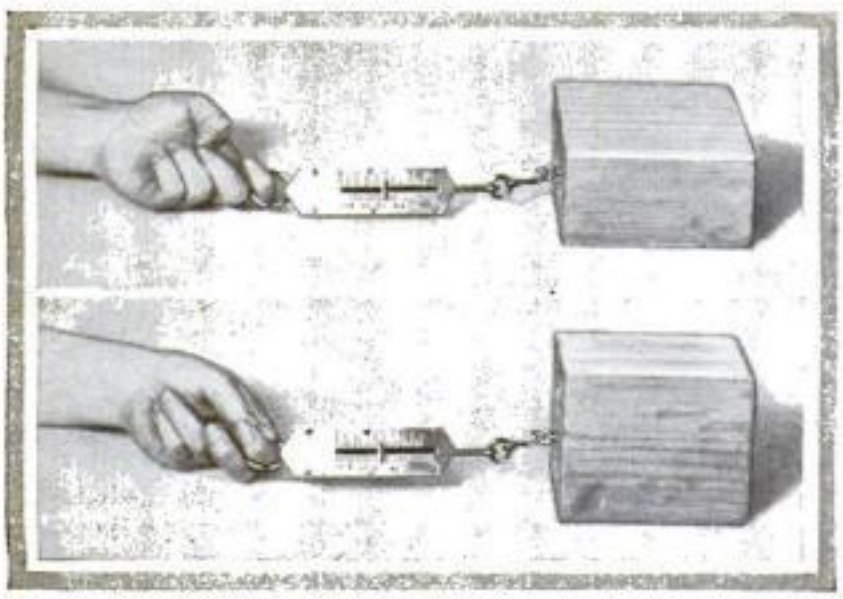


HEAT DIMS A LIGHT. Connect a lamp with a bell-ringing transformer, as above, with a wire coil connected in series with it. Heating the coil dims light as heat raises resistance



SYMPATHETIC VIBRATIONS

The transmission of motion by vibration can be shown by tying two weights to threads of the same length and attaching them to a rod as above. If one is set swinging the other follows it



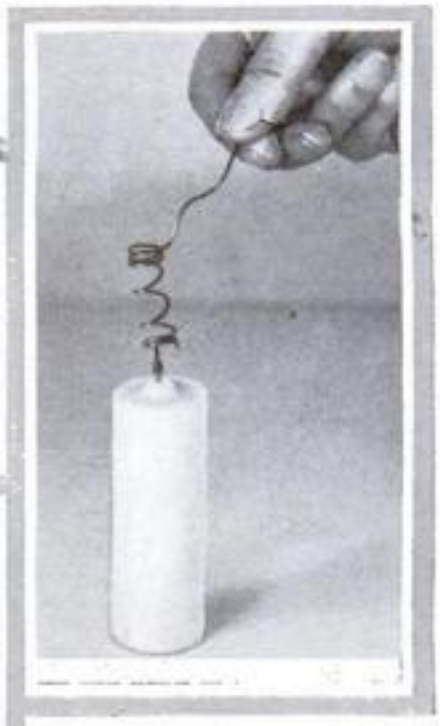
STRANGE LAW OF FRICTION. You can show that friction is independent of the area of the rubbing surface with the experiment pictured above. With a scale, the block is drawn first on its side and then on its edge. The reading is the same in each position

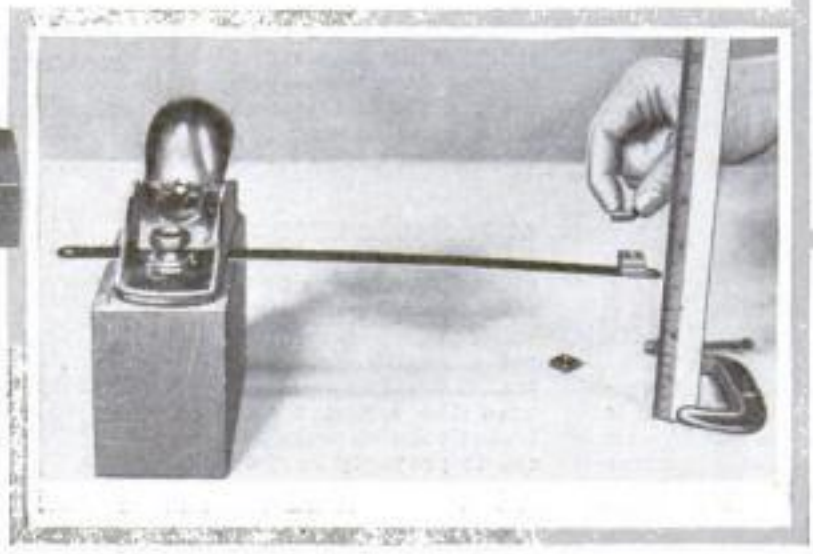
HOT WATER LOWERS LIQUID IN THERMOMETER. Arrange your apparatus as above with water in the flask so it rises in the glass tube. If the pot of hot water is then raised around the flask, water in tube falls as glass expands

CARDBOARD DRAWS NAILS

Cardboard squares, piled one on top of another, are placed in a wooden frame that is fastened with nails. If water is poured over the cardboard, the latter swells and the force exerted will pull the nails and force upward the top board

FLOATING DROP OF WATER. If you heat a silver coin and carefully place a drop of water upon it, the drop remains round. This is because steam supports the drop





HOW STEEL GIRDERS BEND

A hack-saw blade is arranged as shown at the right. It will bend if one small weight is placed on it and it will bend twice as much if two weights are put on. This experiment proves girders bend in proportion to force applied

WIRE PUTS OUT FLAME

A coil of copper wire is inserted into a candle flame. Almost instantly the flame will go out. The explanation is simple. The wiring, in becoming hot, absorbs so much heat, the burning gases are cooled

Latest Kinks in Radio Field

Suggestions to Improve Work of Craftsmen Who Build Their Own Sets

A new speaker-phone adapter and switch that will enable you to use earphones or loudspeaker by the flick of a switch. Detail view of the adapter is shown in illustration at the right

Earphone Adapter Has Speaker Switch

TO SAVE time and trouble in fitting a broadcast receiver with earphones for long-distance reception, the radio fan can make use of the novel adapter and speaker cut-out switch shown in the illustration above.

The adapter is fitted to the prongs of the output tube and inserted into the regular socket, while the switch, equipped with convenient jacks for the earphone tips, can be placed on top of the radio cabinet or on any convenient table. The toggle switch can be manipulated to use either the loudspeaker or the earphones independently.

When using the earphones, the screen-grid circuit is used to protect the delicate coils from the high-plate current. At the same time, the speaker is cut out and the plate circuit is connected properly to avoid any harm from excessive voltages.

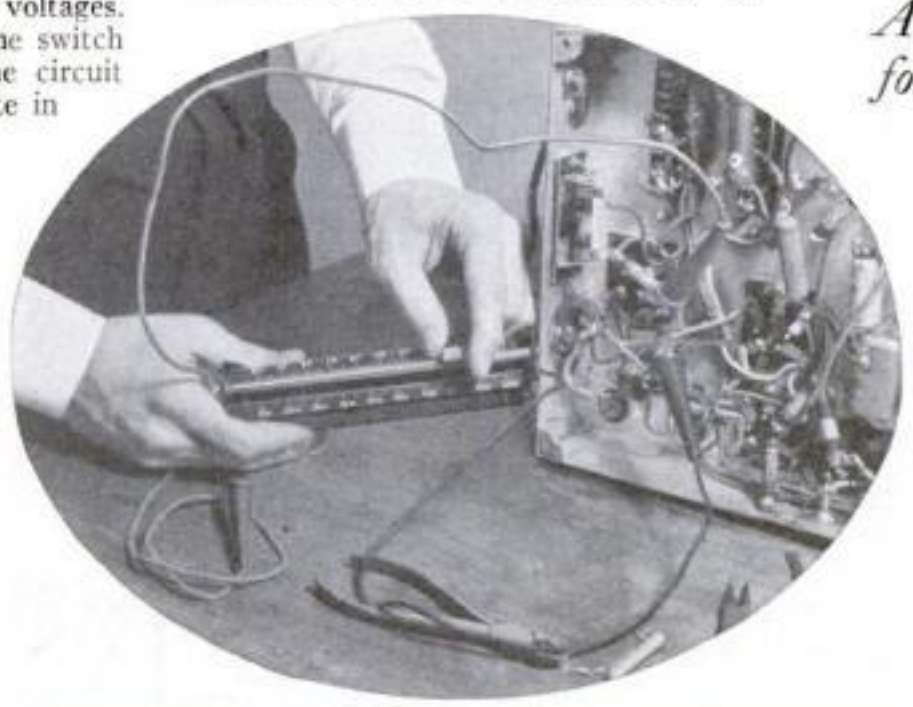
Thrown to the speaker side, the switch shorts the earphones out of the circuit and allows the receiver to operate in the usual way.

Auto Radio Serves In Summer Cottage

BECAUSE it operates entirely from a single six-volt storage battery, the modern automobile receiver forms an excellent unit for use in a summer cottage or vacation camp that is not wired for electricity. One reader of POPULAR SCIENCE MONTHLY, who has equipped his combination hunting lodge and summer cabin with such a unit connected to a regular full-size antenna, finds that he can save on battery charging bills by alternating between two batteries. At the end of every week, he switches the batteries, connecting the one that has been in his car to the power unit of the radio and placing the radio battery in the car. Because most of his summer driving is done during the day, one week in the car will recuperate a battery sufficiently to give a full seven days of radio service.—L. G. C.

Resistance Indicator Gives Accurate Data

SO THE amateur radio craftsman can replace accurately and quickly, faulty resistance units in a receiver, a new type resistance indicator provides a simple method of measurement. Consisting of a large wire-wound resistance and a convenient movable-slider contact, this novel device is in reality a carefully calibrated variable resistance or potentiometer. To measure the value of some faulty unit in a circuit, the resistance in question is removed and two of the three wires extending from the indicator are connected to the free terminals. The slider then is adjusted back and forth until the tone and volume of the receiver is satisfactory or until a voltmeter placed across the resistor reads the correct voltage. When the desired conditions are obtained, the resistance in ohms can be read directly from the scale under the slider. To give a maximum range, two scales are provided making possible readings from 100 to 100,000 ohms. The indicator also can be used as a calibrated potentiometer or adjustable-voltage divider.



Resistance of faulty units in a receiver are measured with this indicator

Airplane Type Dials for Home Built Sets

ILLUMINATED airplane style tuning dials of the type used on the newer receivers now are available for use on home-built sets. Arranged like the dial of a modern automobile speedometer, they give a full view of the entire scale range. To give the best tunning qualities, especially on the shorter waves, these dials are fitted with improved anti-backlash reduction gears, twelve complete revolutions of the knob being required to swing the pointer over the full scale. They can be installed easily on existing sets and thus modernize their appearance.

Hunting Short Waves WITH A REGULAR SET

Often it is possible to alter a broadcast superheterodyne so it will bring in police calls by loosening the adjustment on the oscillator and radio-frequency padding condensers, as is shown at the left

By George H. Waltz, Jr.

ALTHOUGH special receivers give the best results, they are not absolutely necessary to enjoy the thrills of the short waves. The experimenter, armed with a few simple kinks, many times can alter his regular broadcast set to bring in the adventures of the police, aviation, and amateur phone bands.

One of the best ways to make use of a modern broadcast receiver on the shorter wave lengths is by means of an efficient short-wave converter. Such a unit, known as a superheterodyne converter because of its circuit, is illustrated on this page. As shown by the wiring diagram, the converter consists simply of a tuned circuit and oscillator complete with an A. C. power supply. In use, it is connected between the regular antenna and the antenna binding post of the receiver and serves to change or convert the short-wave signals that strike the antenna into such a form that they can be amplified by the regular broadcast circuit.

With such an addition, most of the short-wave bands can be covered. The tuning dial of the broadcast set merely is turned to some relatively quiet point and the condenser in the converter is used as a single control to tune in high-frequency signals. Since the use of a converter does not in any way alter the actual circuit of the broadcast set, but merely acts as an addition, it can be disconnected easily and the receiver will again bring in the broadcast band.

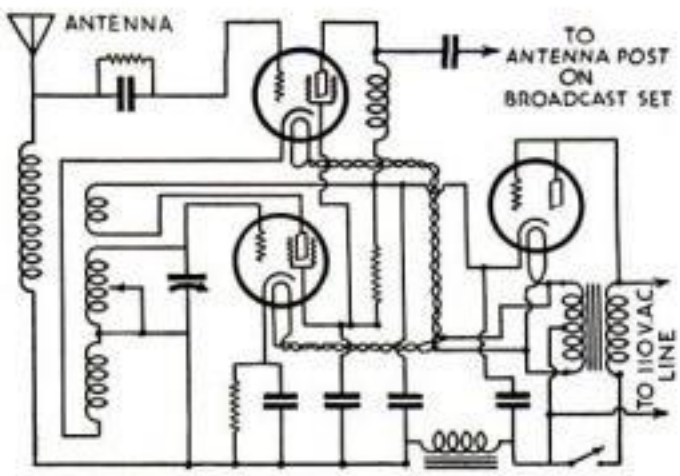
Another simpler, but not so reliable way, of obtaining a similar result with superheterodyne broadcast sets is to connect a special tuning circuit directly to the grid of the first detector tube in the circuit. As shown in the diagram, this method of snaring some of the short-wave thrills consists merely of substituting a short-wave tuning circuit for the one that already exists. For example, if the regular police and aviation bands, as well as a few of the local amateur phone stations, are to be covered, a regular 160-meter short-wave tuning coil used in connection with a variable condenser of the right capacity will serve. If desired, the unit can be permanently installed in the regular receiver cabinet and supplied with a simple change-over switch that will make it possible to use the combination either for broadcast or short-wave reception. The receiver then in effect will become a dual-wave outfit.

To cover the portion of the shorter waves that borders the broadcast band, the two-winding coil should consist of a fifteen-turn primary and a fifty-three-turn secondary close-wound on a one- and one-quarter-inch form. The primary of number twenty-six silk-covered wire should be spaced approximately one sixteenth of an inch from the number twenty-two silk-covered wire secondary. The variable condenser to match this coil should have a capacity of .00014 microfarads.

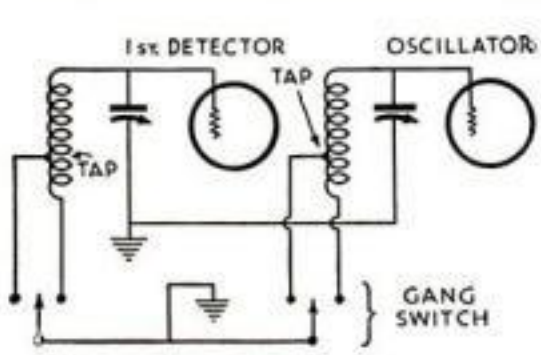
For best results with a minimum of broadcast pick-up, the tuning unit (coil and condenser) should be shielded and the connections to the receiver (grid and chassis) should be kept as short as possible. Experimentally, however, the circuit can be used bread-board fashion at first and shielded later on if the interference prove troublesome and the short-wave results warrant making a permanent set up. An ordinary shielding can will serve as a combined cabinet and shield.

The method of tuning this combination depends on the intermediate frequency of the broadcast receiver. For instance, to tune a 2,000 kilocycle station, the receiver dial should be set at 912½ kilocycles if the intermediate frequency is 175 kilocycles or to 770 kilocycles if the intermediate frequency is 460 kilocycles.

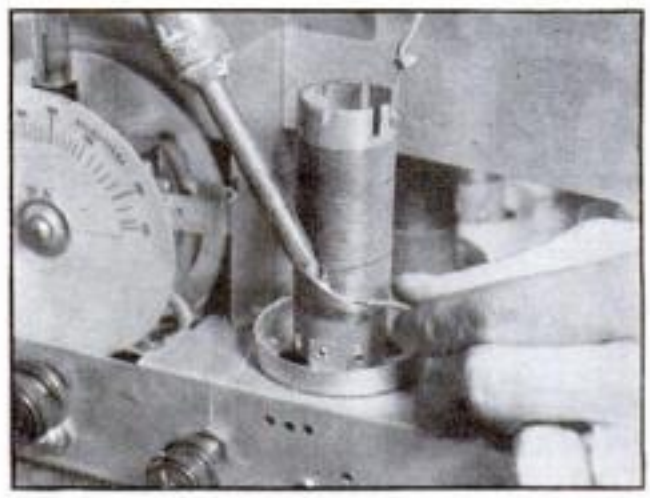
Also, if the receiver used is equipped



Above, left, a superheterodyne converter that can be used in connection with any modern broadcast receiver to bring in short-wave stations. Above, right, diagram of the converter circuit



By fitting the receiver coils in a superheterodyne with properly placed taps it can be made to bring in messages from the short-wave stations. Above, diagram showing position of taps and wiring of switch



for automatic volume control the lower connection from the additional tuning circuit should be made to the corresponding end of the regular first detector input coil instead of to the chassis.

Many commercial broadcast receivers now being sold come already equipped for use on the police and aviation bands. On such a receiver, a flick of a switch serves to change the circuit over to bring in the shorter waves. In most cases, this switch, used in combination with taps, merely reduces the number of turns on various coils in the regular broadcast circuit.

Although it is a delicate job for the beginner, the experienced amateur should have little difficulty applying this same switching arrangement to his regular broadcast superheterodyne. It is necessary only to locate the coils, tap their secondaries at the proper point, and wire the leads from these taps to a convenient gang switch having as many independent pairs of terminals as there are coils.

As indicated, the taps should be made at the ground ends of the secondaries in each case, the number of turns being shorted out, depending on the increase in frequency that is desired. For instance, a change from the lowest regular broadcast frequency of 1,500 kilocycles to the police and aviation bands of approximately 2,000 kilocycles means a change of 500 kilocycles or an increase of one-third the original frequency. To alter the receiver coils

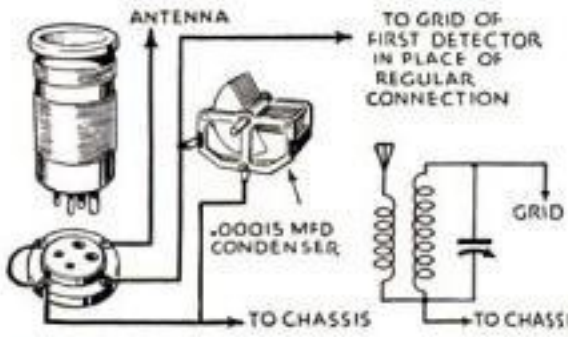


Diagram showing simple short-wave adapter circuit made from a plug-in coil and a condenser

to correspond to this change, it will be necessary to place the tap at a point approximately one-third of the way up from the grounded end of the secondary.

The units that must be tapped in this way are the radio-frequency, oscillator, and first detector coils. Generally, these coils can be found easily by removing the various cylindrical shields that spot the upper face of the chassis. However, if there is any doubt as to their identity, obtain circuit and chassis diagrams of your particular receiver before going ahead with the work.

As with the simpler short wave tuning circuit already described, the actual wiring of the switch will differ slightly from the drawings if the broadcast receiver is of the automatic volume control type. In such a case, the switch arms should not be brought to a common ground. The contact arms of the switches for the radio-frequency and first-detector coil taps instead should be connected to the proper point in the automatic volume control circuit.

Because the leads from the taps to the switch may tend to upset the original circuit, it may be necessary to rebalance and retrack the receiver to make the dial read correctly on the broadcast band. Of course, when the switch is thrown to extend the frequency into the shorter waves, the dial readings will be meaningless.

Still another way of extending the range of a superheterodyne broadcast receiver temporarily to include the low frequency end of the short-wave band is to lift up all the way on the adjustment of the oscillator and radio-frequency padding condensers. Of course, before doing this, some reference mark should be made on the screw and chassis or shield and count should be kept of the number of turns made so that the condenser can be reset without any great difficulty. Obviously, this method of bringing in the shorter waves on your broadcast set is at best a temporary makeshift. For best results, either the three-tube converter or simpler adapter should be used.

BUILDS HIS OWN

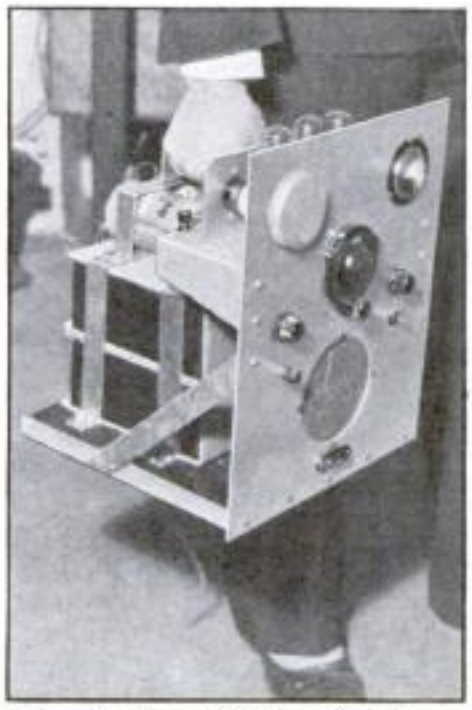
All-Wave Portable

Illustration of manner of mounting Popular Science All-Wave receiver. The case houses the entire set

DESIRING light, portable, all-wave receivers for a summer camp and a cruising sailboat, Walter Bronson, a reader living in New York City, constructed the two units shown.

Although differing widely in appearance, both receivers were constructed according to the simple all-wave circuit diagrams described in a recent issue (P. S. M., Aug. '33, p. 54). The smaller model is attractively and conveniently mounted in inexpensive imitation-leather hand case. As with the original receiver, the outfit is self-contained; housing batteries, earphones, and plug-in coils as well as the six-foot antenna and six-foot counter-poise on which it operates.

The novel marine model, being wired for an additional amplifier and a loudspeaker as recently described (P. S. M., Nov. '33, p. 59) and supplied with a ninety-volt B-battery source, is larger and heavier but ideal for use in a boat. For convenience in carrying, the builder has supplied the sturdy receiver frame with a convenient metal handle.



Here is the All-Wave circuit expanded for use in a sailboat. Note, batteries mounted under handle

Incidentally, this all-wave circuit (15 to 1,500 meters) designed for POPULAR SCIENCE MONTHLY readers by an expert, has met with unusual popularity. Another reader, living in Asbury Park, N. J., reports that since constructing the set last January he has logged stations in England, Germany, Canada, Ecuador, Bolivia, and Brazil as well as in the United States.

In its original form, the two-tube portable receiver was constructed for less than fifteen dollars including the cost of tubes, batteries and earphones.

Saving Dollars *on your* Car

"This is my file of customers and repairs," Gus explained to Walton. As he spoke he began to finger the grease-smudged cards that the small, rectangular box was filled with

By **MARTIN BUNN**

"THIS buggy sure is harder on the gas than the old one I had," complained the owner of a shiny, new sedan that had coasted to a stop beside one of the Model Garage gasoline pumps.

"What sort of mileage do you get?" Gus Wilson inquired as he unlimbered the hose and pushed the nozzle into the filler opening.

In answer, the man pulled an envelope from his coat pocket and thrust it at Gus. On the back was a hastily made tabulation of the gasoline used and the mileage. "About twelve miles to the gallon," the man grumbled. "After thirty years or more of making cars you'd think these automobile engineers could turn out something a little more economical. Now, take those little cars they use over in England—"

"They wouldn't do for you, Mr. Walton," the gray-haired mechanic interrupted. "Ever ride in one?"

"No, but from what I hear they certainly are easy on the gas. Why, I'm told it's nothing for them to give thirty or forty miles to the gallon."

"Sure, but they give less in speed, power, and comfort," said Gus. "They don't use those light, economical cars from choice. They're a necessity. Gasoline is so expensive, they have to sacrifice everything for gas mileage. They don't mind small motors, light bodies, and a four-speed transmission that has to be shifted every time you climb an ant hill. Over here in America, we want speed, comfort, and power, and it takes a heap of gas to carry heavy motors, shock absorbers, and trick clutches.

"IT'S not fair to figure economy by the miles-per-gallon method. Too many things enter into it. Way back in 1904, they had a car that would do twenty miles on a gallon of gas, but I'll bet you wouldn't take it as a trade for the oldest hack on the road today."

"Well, if it's speed that's costing us money, why all the speed?" argued Walton. "Fifty miles an hour is fast enough for me. When I bought this car they told me it would do seventy. But when will I ever need that much speed? If you do over forty-five around here you get a ticket."

"Remember that old open touring car you had back in 1920?" asked Gus with a smile.

"A FINE car!" returned Walton proudly. "Had all the speed I wanted. It went forty-five on the straight stretches."

"Sure, and everyone in the car was gritting their teeth and planning which door they'd jump through if the old can left the road. I know, I had one," chuckled Gus. "And that's the answer to your question about speed. The cars of today are made to do seventy and eighty so they'll be able to travel forty-five safely without jarring your fillings loose. There's some difference between forty-five today and forty-five ten years ago.

"And another thing," added Gus. "Remember how you had to coax those old cars up to speed. Why, jumping from ten up to thirty miles an hour is nothing today. And as far as economy goes, I'll bet you'll spend less on this car than you did on the old one."

"Maybe," agreed Walton. "But I'm going to do something about that gas mileage, too. When she gets broken in, I think I'll let you check up on that carburetor."

"That'll help," nodded Gus. "And there are lots other things you can do to save money."

"What?" inquired Walton, interested.

"Well, in the first place, you want to give these tires of yours a little thought," Gus advised. "If you go easy on the speed and easier on your brakes, you can just about double the life of your shoes. They'll be good for all of 20,000 if you're careful, but they won't last 10,000 if you ride them hard. Even figuring on a cheap set of tires, that means about twenty-five or thirty dollars.

"It may sound silly, but engineers claim that even the roads you use have a lot to do with the cost of running your car. They've figured that if you can use concrete instead of macadam, you can save as much as two cents a mile on gas, oil, and wear.

"AND while we're on the subject, oil's another thing that can put a crimp in your gas mileage. If it's thicker than it should be, it adds just that much more to the work the motor has to do."

"Oh, I suppose those things mean something," agreed Walton. "But the real costs are gas, oil, and repairs."

"And you can cut down on the repairs too, if you're careful," answered Gus. "Wait a minute and I'll show you what I mean."

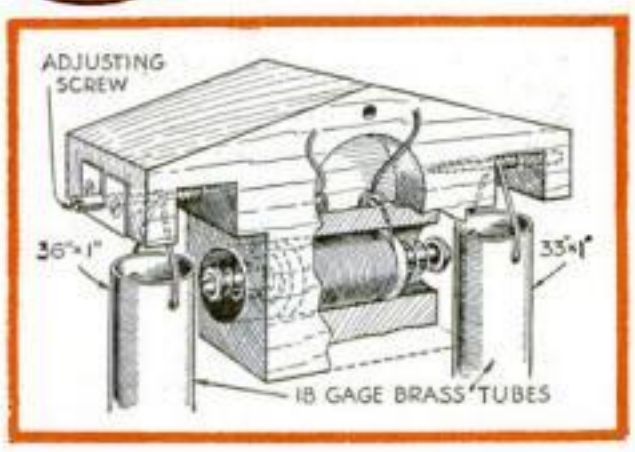
With that Gus disappeared through the door to the garage office. When he reappeared he was carrying a small rectangular box. "This is my file of customers and repairs," he explained as he approached Walton. "It's an illustrated story in itself."

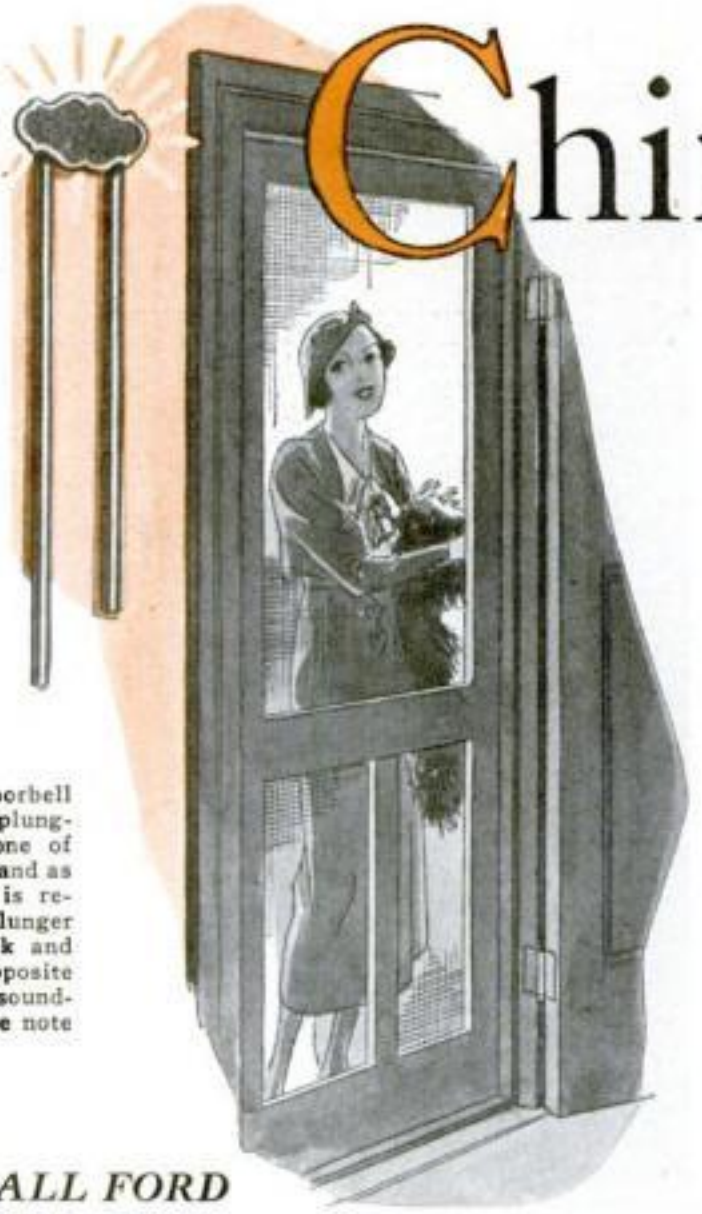
As he spoke, he began fingering the grease-smudged cards. *(Continued on page 115)*

How to Make a Set of Musical

Electric Chimes

to replace your noisy old doorbell





When the doorbell is pushed, a plunger strikes one of the chimes, and as the button is released, the plunger springs back and hits the opposite chime, thus sounding a double note

IN MODERN homes, the harsh sound of the doorbell or buzzer is a discordant note that is both antiquated and unnecessary. It should give way to the soft, melodious, yet arresting tones of the chime. Although expensive to buy, suitable door chimes are easy to construct and the equal of those selling for many times their cost.

By
KENDALL FORD

The body is cut from a block of wood 3¼ by 6 in. and approximately 2 in. thick. The finished thickness may vary a fraction of an inch either way from that shown in the drawing if the dimensions given in Fig. 2 of the working drawings are changed accordingly. To avoid splitting, select a piece of wood that is soft and of fairly close grain.

Cut the block to the shape shown in Fig. 1, and bore a 1-in. hole from end to end in the lower part to hold the coil. In the back of the block bore a recess 1½ in. in diameter and approximately ¾ in. deep to provide space for the terminal screws and surplus connecting wire. The lower part of the recess should break slightly into the hole provided for the coil, which will give sufficient space for the coil terminals to pass through.

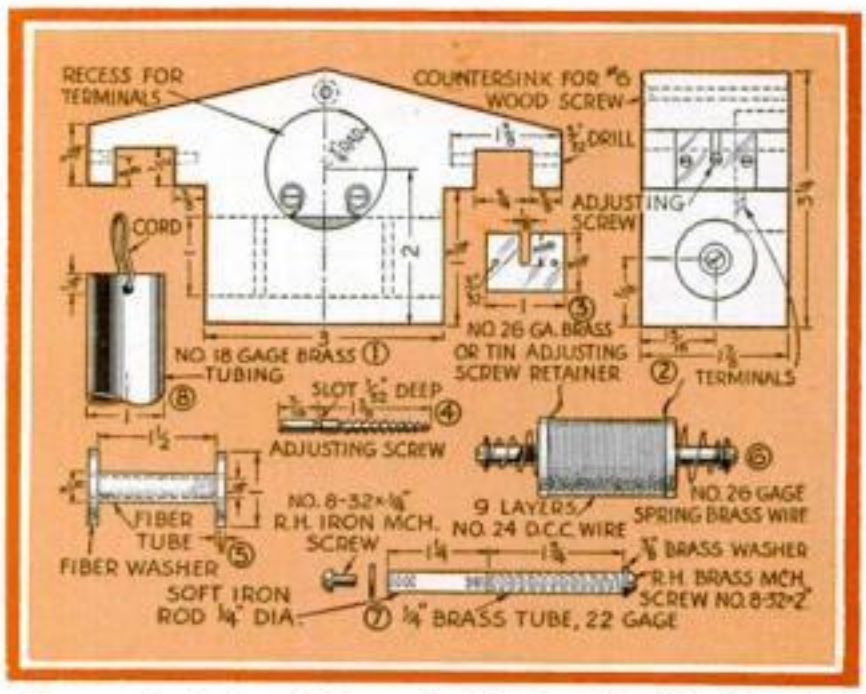
At each end of the block, drill a 5/32-in. hole in the center to a depth of 1⅜ in. as shown in Fig. 1. This hole is for the adjusting screw, Fig. 4, which is made from a 2-in. No. 8 flathead wood screw. A circular slot, the inside diameter of which is ⅛ in., is cut in the screw as shown. The slot in the adjusting-screw retainer, Fig. 3, prevents the adjusting screw from moving out of place when adjustments are made. The screw retainer may be made of either tin or brass.

The adjusting screw and retainer are shown in place in Fig. 2, but the plate is not to be fastened permanently until the brass tube is suspended from the adjusting screw. The head may be removed from the adjusting screw and a slot cut in the end of the screw to give it a finished appearance, as shown in Fig. 4.

The form for the coil, Fig. 5, consists of a piece of fiber tubing ¼ in. in inside diameter, ⅜ in. in outside diameter, and 1¾ in. long, and two fiber washers 1 in. in diameter and ⅛ in. thick. The washers are drilled out to ⅜ in. and forced over the ends of the fiber tubing.

Wind the form full with No. 24 double cotton-covered wire. If the winding is done carefully, there will be room for nine layers or 480 turns. The winding must not extend over the width of the fiber washers, otherwise it will be impossible to force the coil into the hole

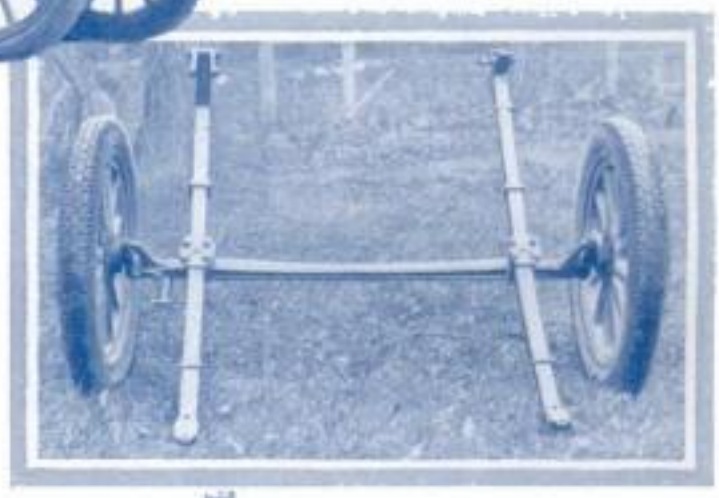
(Continued on page 93)

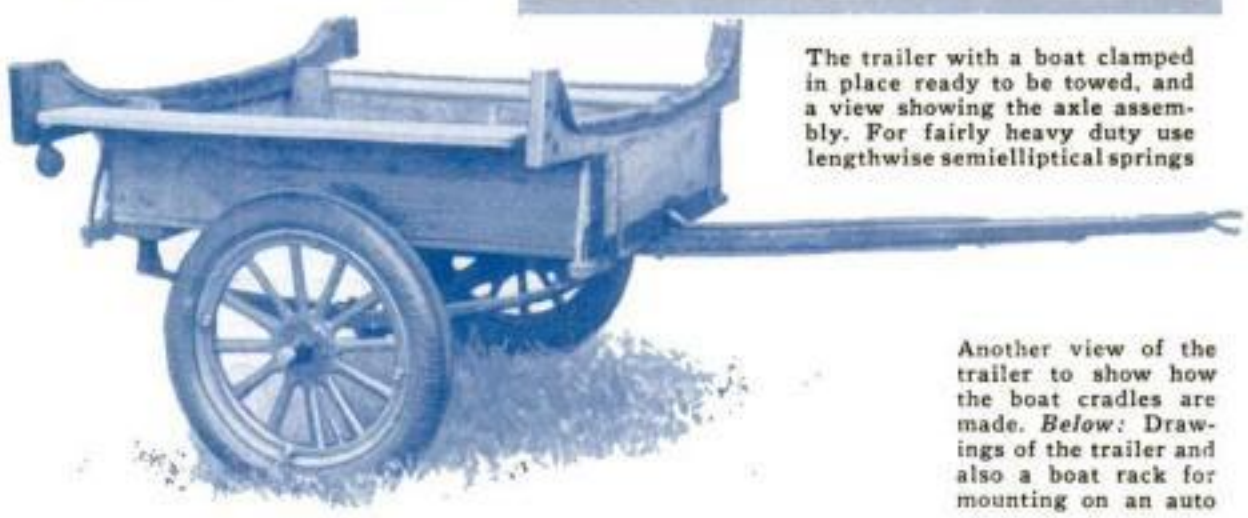


Front and end views of the wooden block, and details of the coil, plunger, adjusting screw, retaining plate, and upper end of tubes

EASY WAYS TO BUILD A Trailer *or for Carrying*

A junked front axle assembly in good condition forms the foundation for a boat trailer. The wheels must be lined up and locked in position





The trailer with a boat clamped in place ready to be towed, and a view showing the axle assembly. For fairly heavy duty use lengthwise semielliptical springs

Another view of the trailer to show how the boat cradles are made. *Below:* Drawings of the trailer and also a boat rack for mounting on an auto

By William Jackson

A WELL-BUILT boat trailer or an automobile boat rack will greatly extend your enjoyment of boating. They make distant bodies of water easily accessible, with corresponding interest in fresh sights and in the adventure of exploring new waterways. They enable you to enjoy a racing boat, sailboat, or motorboat even though you live at a distance from the water, and they afford complete freedom from the ever-present possibility of theft or damage to the boat or motor. The last advantage alone makes the initial investment well worth while.

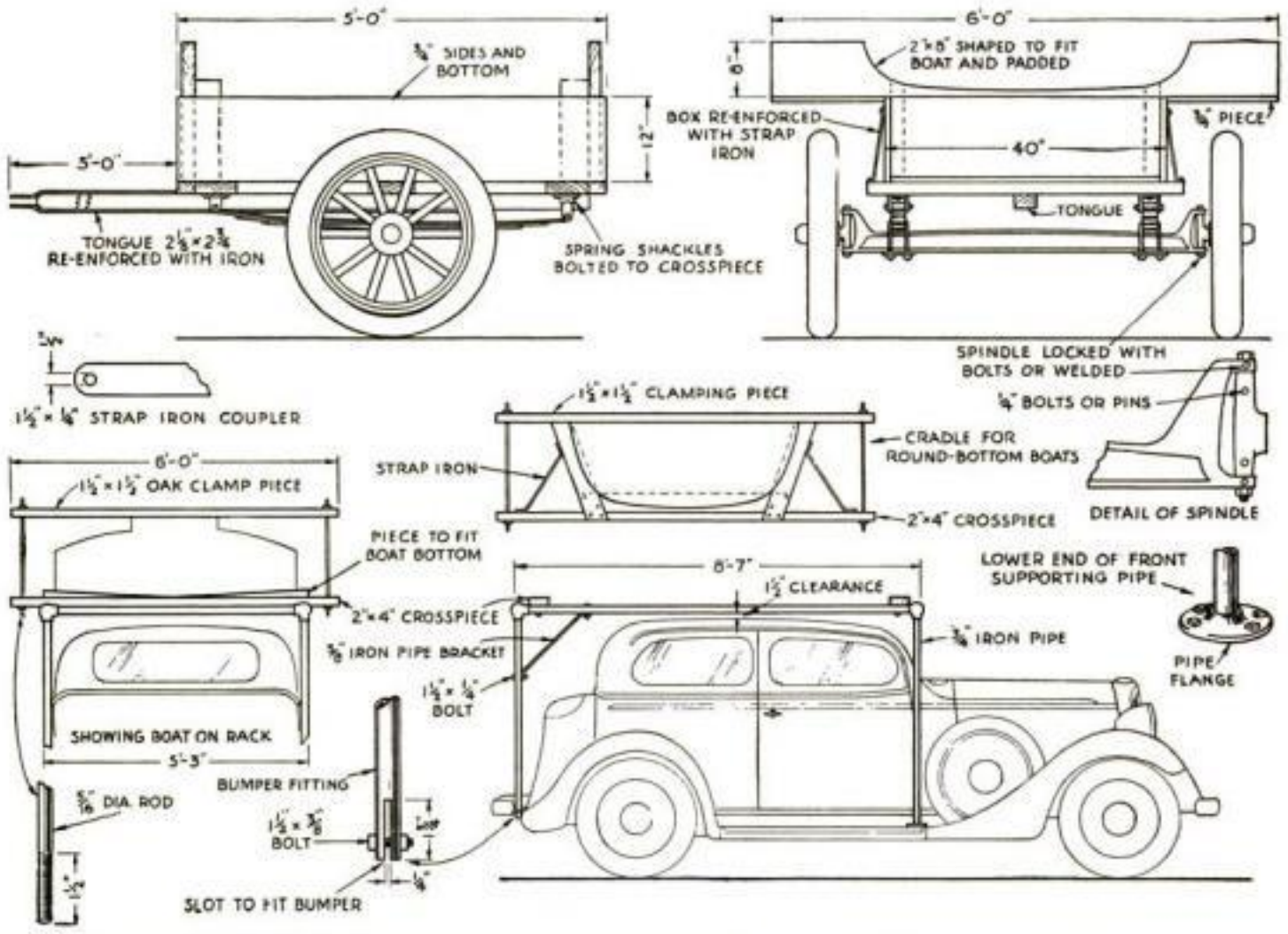
A trailer is more convenient than a rack attached to your car because it may be easily detached and parked, leaving the car free for sightseeing and unencumbered with luggage. Not only for boats but as luggage carriers, for camping, and for uses about the farm, home, and small business, these small trailers are time-savers and most economical.

The home-built trailer illustrated cost about $15 to construct. The cost will depend of course, upon what material is purchased new and what is bought at the junk yard.

The type and dimensions of the trailer will depend upon your particular requirements. While a box body may be desirable for camping, a substantial oak frame will suffice for the sailboat or motorboat. Bolt the members securely together and reënforce wherever necessary with strap iron.

The front axle assembly may be purchased cheaply at the local junk yard or the used-car graveyard. The points to look for are: true-running wheels, good bearings, well-fitting axle assembly, and, if possible, wheels the same size as those on your auto. In the event of a puncture, the car "spare" will then suffice. Tires and lumber should be purchased new. Be sure to retain four spring shackles for each end of the springs.

An old Ford model "T" front axle assembly may be used for a trailer that is to carry light loads, but will have a tendency to rock. Where more



BLUEPRINTS for Popular Science Monthly projects are listed on page 80.

Auto Rack

Your Boat

By using two inflated inner tubes as pads, a light boat may be carried on top of an auto with safety

than usual service is required, choose an axle assembly with lengthwise semielliptical springs.

After hauling the axle assembly home, line up the wheels and securely lock them in one position. This is accomplished by clamping, welding, or securely pinning the kingbolt in the spindle housing. As kingbolts are ordinarily tempered so hard they cannot be drilled without difficulty, remove them and draw the temper. This is effected by heating the bolts to a red heat and allowing them to cool slowly. Reinsert the kingbolts, drawing the nuts up tight. After drilling ¼-in. diameter holes through the spindle housing and kingbolt, insert ¼-in. steel pins or bolts.

The frame or box for the boat or for luggage, as the case may be, is securely bolted to the spring shackles. For boats, a flat oak framework should be built, with shaped and well-padded pieces to fit the boat bottom. The length of the trailer tongue will depend upon the boat carried; that indicated on the drawings will be about right for most purposes, except where a longer boat than ordinary is to be carried. Make the tongue of heavy oak, bolting it securely to the underside of the trailer. If possible, reënforce the tongue with flat iron.

A sturdy coupling device is bolted to the trailer tongue and a corresponding unit attached to the car. The hitching arrangement will depend somewhat upon the load carried. For light loads a bumper attachment may be utilized, but for heavier loads the trailer tongue should be attached to the chassis of the car with a strong, heavy coupling device. A blacksmith or garage will aid in making a strong coupling for your particular car, or you can buy something suitable from dealers in trailer parts or from one of the large mail order houses.

If a round-bottom boat is to be carried, a cradle and clamping device similar to that used upon the boat rack is utilized. A tail light or reflector should be carried on the rear of the trailer. A license is also required on trailers. If long trips are contemplated, some means of greasing the chassis should be provided.

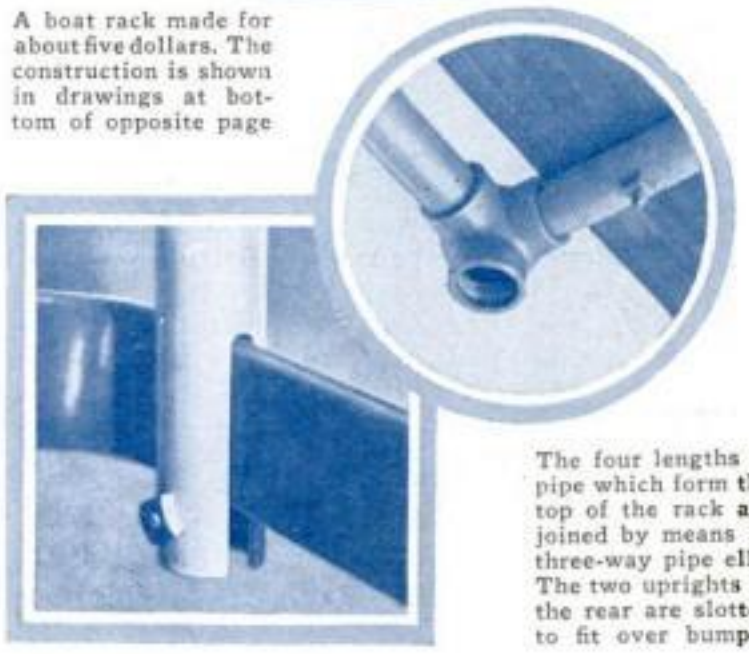
Instead of being carried on a trailer, light boats can be fastened on the roof of the car, as illustrated in the smaller photograph above. Obtain two large inner tubes and inflate them until they are without wrinkles. Place the tubes on top of the car, front and rear, near the center of the roof. Lift the hull upon the tubes so the weight is evenly distributed. Tie the front, rear, and sides down securely. The boat will have little tendency to wabble and the car will ride easily.

A still better method is to construct a boat rack. With an investment of about five dollars, a rack may be constructed like the one illustrated. For a cheap, practical, demountable carrier, this is unexcelled, and it makes parking easy in congested places. Quantities of luggage, camping equipment, or an outboard motor may be carried inside the boat. The drawings give complete details.

The frame is constructed of ¾-in. inside diameter iron pipe. New pipe with fittings will cost about five dollars, but if used or junk pipe is available, the cost may be reduced to two or three dollars. Although the dimensions given fit the 1933 Plymouth, these measurements can be easily adapted to any car.

As shown on the drawings, the top of the rack consists of two pieces of ¾-in. pipe 8 ft. 7 in. long, and two lengths of 5 ft. 3 in. Each length is threaded at both ends, with one end of one of the lengthwise pipes threaded extra long—about 2 in. from the end.

The four lengths are joined together in the form of a rectangle with one ¾-in. three-way pipe ell at each corner. That extra threaded length of pipe will enable you to get the last joint of the rectangle together. With the three sides of the rectangle completed, simply screw the extra length twice as far into the ell as ordinarily. The other end is now started into the opposite ell by unscrewing the pipe, so that the extra long threads, in unscrewing, enable the pipe to enter into the opposite ell and complete the frame.



A boat rack made for about five dollars. The construction is shown in drawings at bottom of opposite page

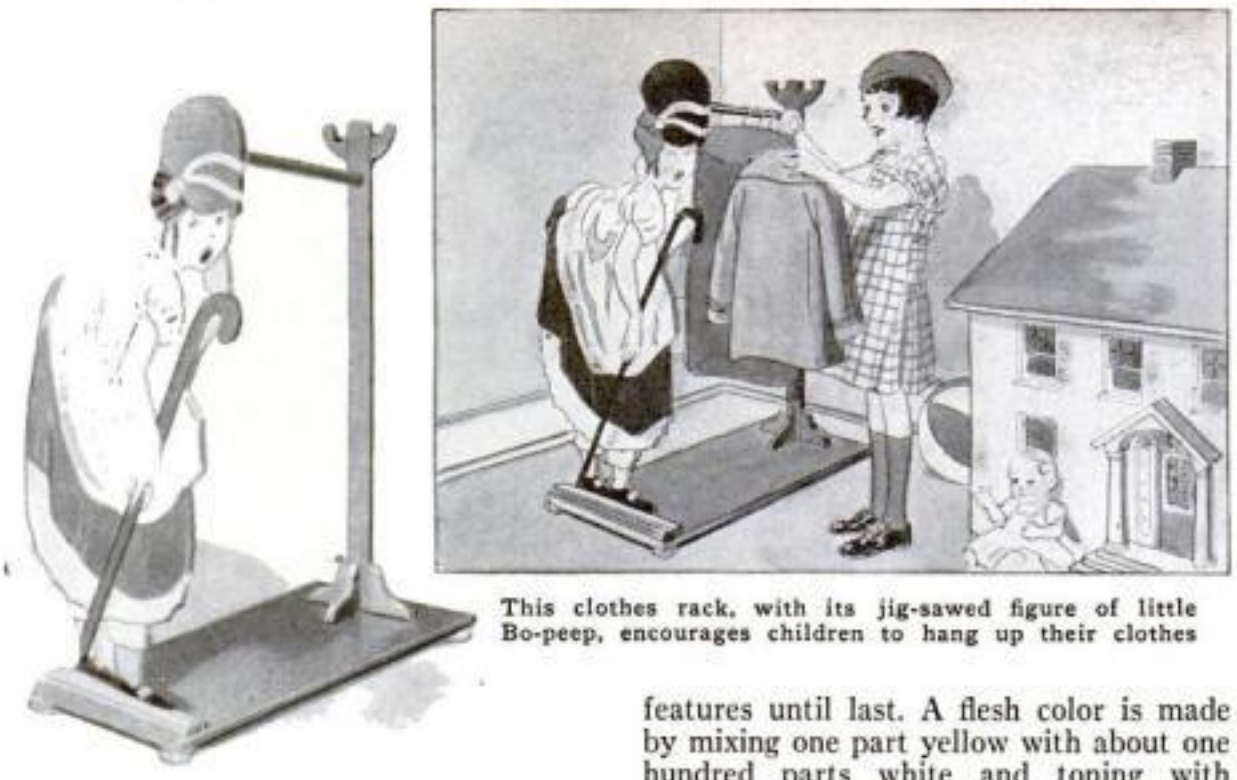
The four lengths of pipe which form the top of the rack are joined by means of three-way pipe ells. The two uprights at the rear are slotted to fit over bumper

The uprights are cut to fit, allowing the rack to rest level with about 1½-in. clearance between the rack and the car roof. The two front uprights are threaded both ends. The two rear uprights are each threaded on one end, and the other ends are drilled and slotted deep enough to fit the bumper, permitting ¾ in. of the pipe to project below the bumper. Drill ⅜-in. holes in the slotted end as shown.

Two ¾-in. flanges are fastened to the front uprights, and the uprights are screwed into the forward ells. The rear uprights are now threaded into the after ells, while the slotted bottom ends are slipped over the bumper and secured with two 1½ by ⅜ in. machine bolts. Each flange is fastened to the running board with four 1½ by ¼ in. stove bolts. Two by 4's, each 6 ft. long, are butted against the ells and bolted front and rear through the pipe after the necessary ¼-in. holes have been drilled, with one 3 by ¼ in. machine bolt at each side.

If a V-bottom boat is to be carried, wooden crosspieces 1½ in. thick are sawn to conform to the shape of the bottom at the front and rear, and are nailed to the 2 by 4 in. pieces as *(Continued on page 98)*

BO-PEEP HOLDS UP A CLOTHES RACK



This clothes rack, with its jig-sawed figure of little Bo-peep, encourages children to hang up their clothes

CHILDREN are much more likely to hang up their clothes neatly when they have such an attractive and convenient clothes rack as the one illustrated. Little Bo-peep and the baseboard are made of ½ or ⅝ in. thick plywood. Bo-peep is cut from a piece 15½ by 31 in., and the base is 11¾ by 31 in. The clothes tree is merely a stick 1 by 1¼ by 36 in. with two wooden hooks screwed near the top.

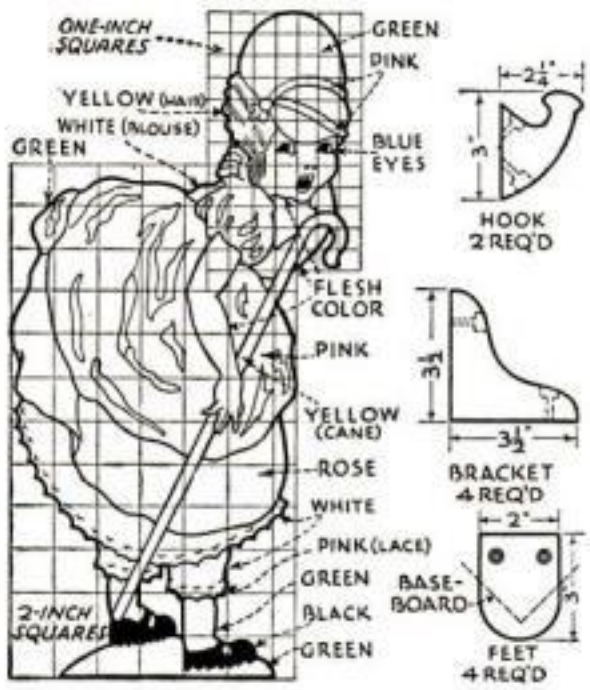
By marking 2-in. squares on a large piece of heavy wrapping paper and subdividing some of them into 1-in. squares as shown, you can make a fairly close reproduction of Bo-peep. The squares of the head were made 1 in. to enable a more accurate drawing of the features. The full-size drawing can then be transferred to the plywood and jig-sawed.

Sandpaper Bo-peep and the baseboard and give each a coat of shellac and two coats of white paint. The baseboard is then finished with green.

The clothes tree is held in place by four wooden brackets screwed to the baseboard at the end opposite Bo-peep. It is painted a light brown.

The features are traced on Bo-peep very lightly with a pencil on both sides. Paint the light colors first, leaving the facial features until last. A flesh color is made by mixing one part yellow with about one hundred parts white and toning with bright red. All colors, when dry, are outlined in black.

Bo-peep is held in place with quarter-round molding screwed to the baseboard. The rack is a piece of broomstick screwed on the hat and clothes tree at the same height. In other words, the broomstick should be horizontal. Four feet are added as shown.—RAYMOND PETERSON.

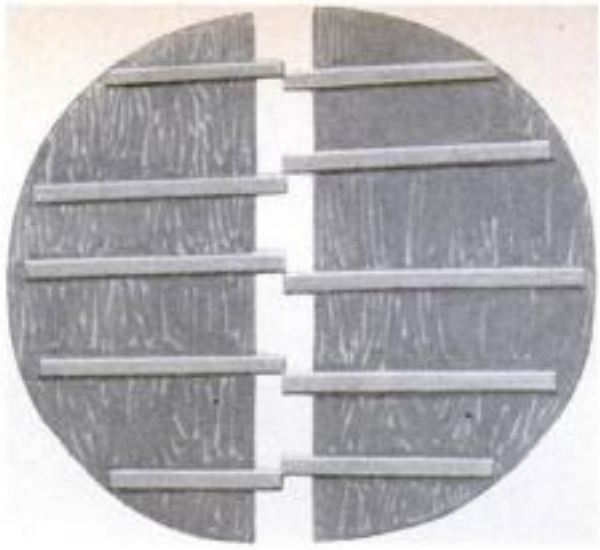


DRIPLESS WATERING CAN

The slender spout of this homemade indoor watering can reaches within the foliage without spilling a drop on the furniture

IF YOU make a watering can as shown for indoor use, you will get the water where it should be—on the plants. Its long slender neck will penetrate the densest foliage. The materials needed are a 1-lb. coffee can, 2 ft. of ⅜-in. copper tubing, and a tin roll or form of the type on which adhesive tape is sold.

The spout is 14 in. long, bent as shown, and soldered in a hole near the bottom of the can. A 1/16-in. wire is soldered to the spout and into a hole in the side of the can as a brace or support. The handle is made from the remaining 10 in. of tubing. For filling, a hole large enough for the adhesive tape roll to pass through is made in the lid of the can. The roll is then placed in position and soldered. This finishes the edge of the hole nicely. The can shown was painted green, except the copper tubing, which was polished.—DANIEL REYNOLDS.



PLYWOOD TOP ENLARGES SMALL DINING TABLE

IT IS occasionally desirable to increase the size of a small dining room table by making a large false top. In this way a table that ordinarily allows room for only three or four persons may be temporarily enlarged for six or eight.

The false top illustrated was made in two pieces for convenience in handling and storing. Threeply veneer ⅜ in. thick was used. It is necessary to use thin wood in order not to increase the height of the table, yet the top must be rigid to prevent any springiness in the overhanging part. Two semicircles were cut on a 27-in. radius, giving a top 4½ ft. in diameter. This will seat six people comfortably. Then five cleats of the same wood were fastened to the back of each piece with ⅝-in. No. 7 flathead brass screws. Each cleat overlaps the straight side of the semicircle by 3 in., as shown. The five cleats on one half of the top are placed so that their overlapping ends will lie snugly against the cleats on the other half and also alternately on the left and right sides of the latter cleats. When the two halves are pushed together, the cleats mesh closely.—EDWARD A. HINE.

With this extension top, a relatively small table may be used for a dinner party of six

PARAFFIN-SOAKED CORKS CAN BE BORED EASILY

ALL difficulty in boring holes in ordinary cork stoppers may be overcome by first boiling the corks in paraffin until they are saturated. Allow them to cool thoroughly, and then make the holes with an ordinary drill. Such corks are proof against acid and, of course, will not become water soaked.—R. R. A.

DIRECTORS AT WORK

A meeting of the Guild directors. Left to right are M. Allen Warren, counsel, Robert A. Horner, vice president, LeVern T. Ryder, president, E. Raymond DeLong, secretary, and John Hendry, Carroll Carlson, Bert O. Schmaling, three of the directors

Official Magazine
POPULAR SCIENCE MONTHLY

HOME WORKSHOP CLUBS

SHOW RAPID GAINS

HOW well the National Homeworkshop Guild is progressing in its efforts to unite the amateur craftsmen of the country into one great organization is being demonstrated by the steady increase in membership of the various local clubs that have already been chartered. Many clubs gain new members at each meeting.

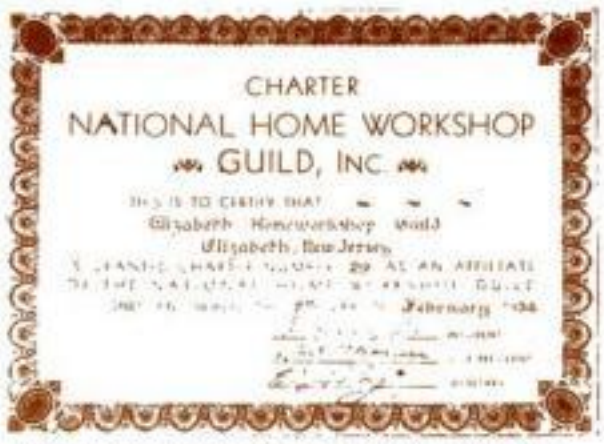
If no club has been organized in your own locality, now is the time to get one started. You can do this without the slightest difficulty because the Guild has a complete, well-tested plan that tells how to find men who will be glad to join with you, how to hold an organization meeting, how to conduct the club meetings and all club activities, and how to plan instructive and entertaining programs.

The advantages of belonging to a home workshop club are obvious. It supplies the one thing that craftwork has heretofore lacked—companionship and coöperation with others. It gives you an opportunity to enjoy the good-fellowship of others who are interested in the same hobbies as yourself, to learn better methods of craftsmanship, and to work together on joint projects either for the club, the community, or individual use. It makes it possible for you to exhibit your handiwork where it will be genuinely appreciated and to receive the aid of the Guild in so large a variety of ways that it is almost impossible to list them all. The Guild and POPULAR SCIENCE MONTHLY, its official magazine, now form the great centralizing organization in the home workshop field.

Strictly noncommercial and organized without any thought of profit for itself or its officers, the Guild has no other purpose than to promote the use of leisure in all hobbies relating to the home workshop field. For full information, fill out the coupon at the end of this article.

What Clubs Are Doing . . Novel Projects Made by Members . . Complete Official News of the NATIONAL HOMEWORKSHOP GUILD

By
E. RAYMOND DELONG
National Secretary



What the charter issued to each club looks like—of course, on a greatly reduced scale

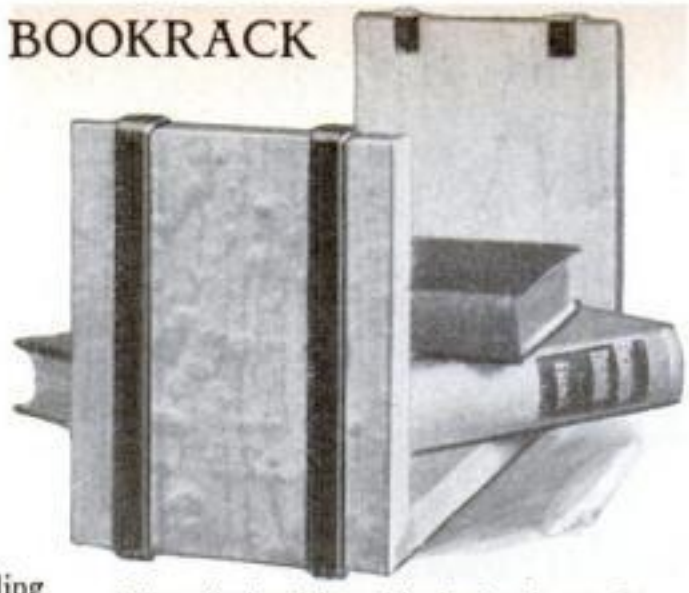
To each member of a local club, the Guild issues its official affiliate card. This is now the passport of the homeworkshop fraternity and entitles the holder to many benefits that will help him in his work and save him money. Be sure that you become a member of this organization, even if you have to start a club yourself, and make use of all the advantages and opportunities thus opened to you.

The competition among the clubs for new members is growing keener. The Amarillo Homeworkshop Club of Amarillo, Texas, had forged to the front and tied the Topeka Homeworkshop Club, of Topeka, Kans., with a membership of thirty-eight. The parent club in Rockford, Ill., of course, is larger. Other clubs that have shown excellent increases since the last report are the Denver Homeworkshop Club, Denver, Colo., the Cleveland Homeworkshop of Cleveland, Ohio, and the Billings Homeworkshop Club of Billings, Mont.

This trend toward increased membership is a very healthy and promising one. No home workshop club should be founded on the idea of a small, exclusive organization with limited membership. The more hobbies represented in a club, the easier it will be to devise entertaining programs and to coöperate in the hundred and one activities that make a club successful.

The Billings Homeworkshop Club, which meets in the homes of the various members, has developed a unique way of signalizing each meeting. An illuminated sign has *(Continued on page 90)*

MODERN-LOOKING BOOKRACK



What distinguishes this bookrack are its bold, modernistic lines and the vivid contrast of walnut strips against light maple

A BOOKRACK is an attractive and useful addition to a desk or table, and by many is preferred to the usual book ends, which are more likely to slip and slide around. The one illustrated is a modern design, distinctive through the contrast of the woods used. By the selection and finish of the woods, it may be modified to harmonize with other furniture.

This rack is made of maple, with walnut strips inlaid in grooves on the ends and bottom, and finished in clear lacquer, rubbed and polished. The part of the walnut strips extending beneath the bottom serves as a support.

The maple is left in one piece while the grooves, ½ in. wide and ⅛ in. deep, are cut on a dado saw. If the saw is not available, a combination plane may be used.

The ends are next cut to length and squared; and notches are cut on the upper edges to receive the thick ends of the walnut strips, and on the lower edges to receive the walnut strips by which the rack is supported. Glue and flathead wood screws 1¾ in. long fasten the ends to the base. The screw heads are countersunk in the bottom of the grooves.

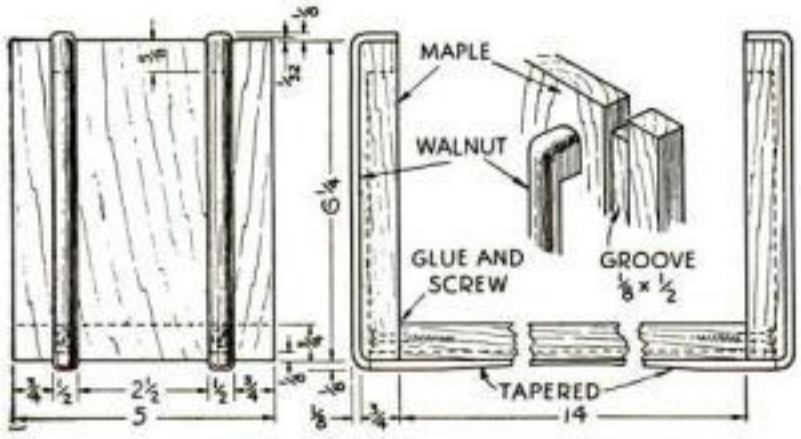
The strips on the ends, of selected walnut, are cut with a block at the top to fit the notches, thus eliminating a joint in the walnut strip at this point. The outer faces should be smoothly rounded, and filler applied before these strips are glued in place. The bottom strips, made thinner at the center to leave the support at the ends, are next glued in place.

After the glue has set, the corners where the strips join are neatly rounded and the entire rack is sanded smooth, with the corners very slightly rounded.

Clear lacquer gives a hard, durable finish. It may be sprayed on or brushed, but if brushed, care must be taken to work rapidly to avoid unevenness. Several coats are necessary to give thickness enough to rub down to a smooth finish. If, after applying several coats, the surface is uneven, a sharp cabinet scraper will remove the high spots, saving much time in rubbing down. Rubbing with No. 7/0 or 8/0 waterproof garnet paper and water gives a smooth satin finish. Care must be taken to avoid rubbing through the finish on the edges.

If desired, the lacquer may be rubbed to a polished finish with rottenstone and water. A lacquer polish, as used for automobiles, is also satisfactory.

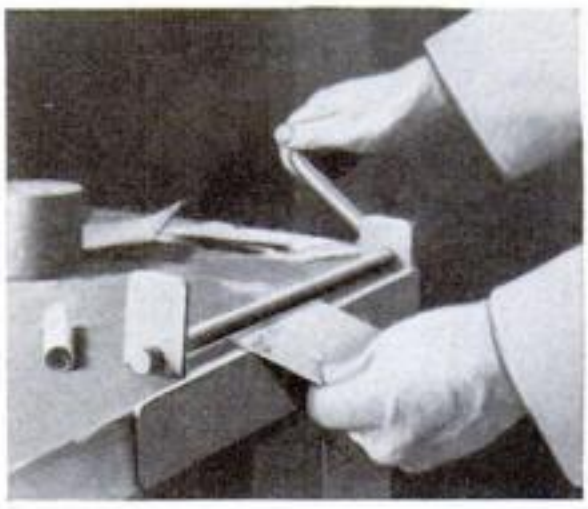
The design may be varied by the use of different woods, or by using the same ones in reverse order, depending upon the material at hand and the taste of the builder.



How the bookrack is made and the walnut end strips fitted. Other woods may be used if they provide sufficient contrast

OLD AUTO CRANK SERVES AS A FORMING ROLL

AN OLD automobile crank, or a rod shaped like one, if slit down the middle and inserted in the turned-up ends of a section of angle iron, makes a cheap and serviceable forming roll for light sheet metal. A square or triangular shaped rod may be used the same way by rounding the parts that pass through the bearings. The supporting angle is screwed to the edge of the workbench as shown in the photograph below.—JOSEPH C. COYLE.



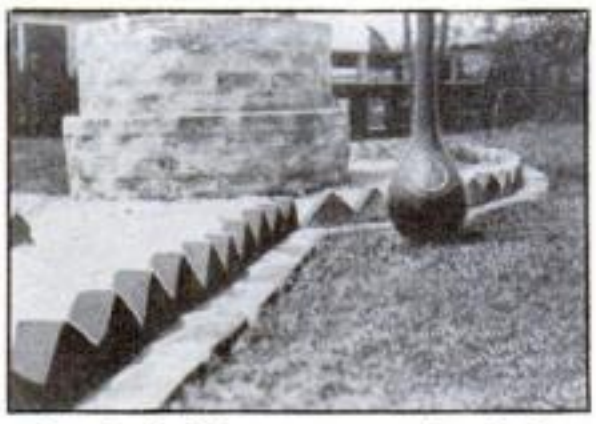
Forming cylinders of light sheet metal with a roll made by slotting and mounting a crank

BRICK EDGING IS AID IN TRIMMING LAWN

EDGING a lawn by the method illustrated below makes it possible to run one wheel of the lawn mower over the bricks. This eliminates the tedious task of clipping the edge of the grass by hand. Another advantage is that the grass will not grow in between the bricks, as they are cemented together.

First dig or hoe out a trench about ½ in. deeper than the thickness of the bricks and about 8 in. wide. Use a spade to cut the sod along the lawn side of the trench so the bricks can be placed close to the grass. Mix 1 part cement to 5 parts of sand thoroughly before adding water. Then add enough water to form a medium mixture. A 100-lb. sack of cement will make enough mixture to lay about 80 ft. of bricks in this manner.

Place enough cement in the trench so that those bricks which are to be laid flat will be flush with your lawn. Put some cement between the edges of these bricks while laying them. After they are placed, start the angular row. This row is placed on edge at 45 deg. Cement these the same as the others. This will give a neat edge around your lawn, and the bricks will not get out of place.—J. P. KNIPP.



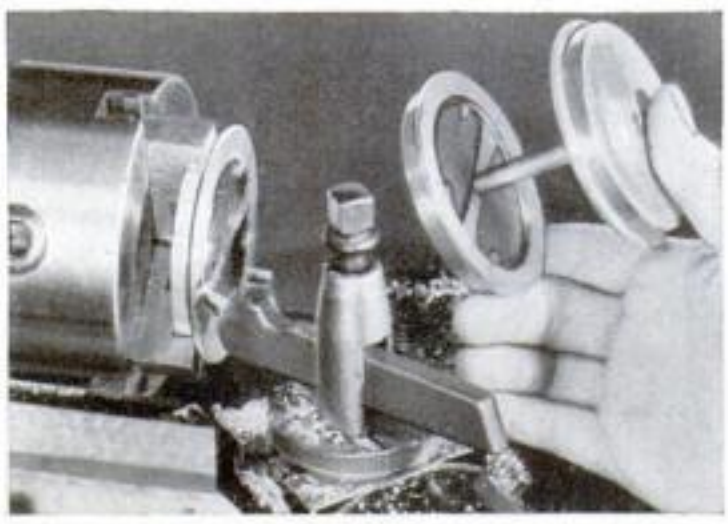
One wheel of the mower runs along the flat bricks so that no hand trimming is required

PISTONS MADE INTO MODEL WHEELS

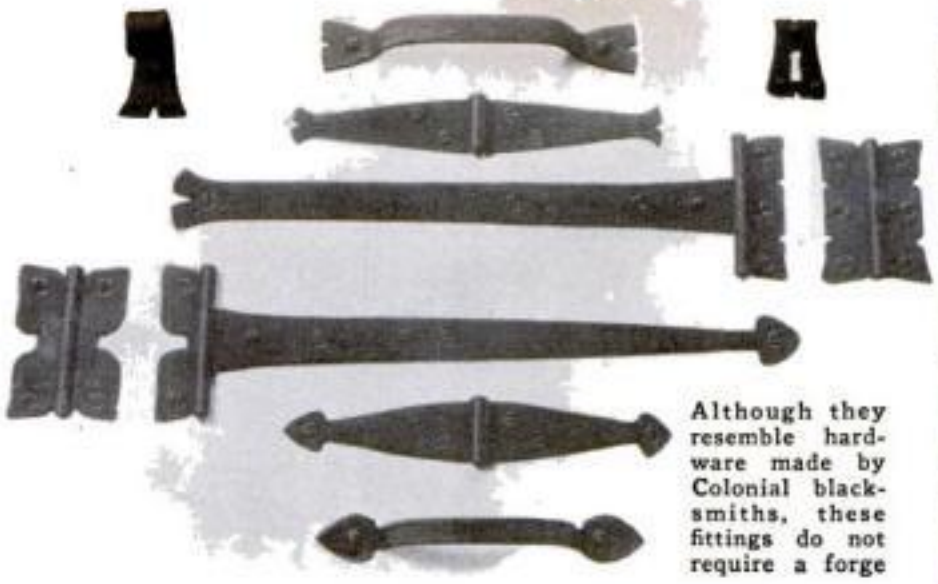
YOU can make excellent disk-type wheels for model electric locomotives at trifling expense from old auto pistons.

The pistons are chucked by clamping on the skirt after shimming the slot, if of the split-skirt type. Turn the rim, leaving the tread straight. Next cut off with a gooseneck cutting-off tool or a hack saw. Reverse in the chuck, holding by the tread, and turn the back. Reverse again, holding by the flange, and turn the tread to an angle of about 5 deg., and also finish-face the wheel. The hollow can be turned by rotating the compound rest, or if a sharper radius is desired, a tool point can be ground to the desired curve and the radius made by taking successive cuts.

If great accuracy is desired, drill with a smaller drill and finish the hole with a boring tool.—FRED BAUER.



Wheels for model locomotive turned from pistons



Although they resemble hardware made by Colonial blacksmiths, these fittings do not require a forge

FINE-LOOKING

Hand-Wrought Hardware

MADE FROM CHEAP STEEL HINGES AND ORDINARY BAND IRON

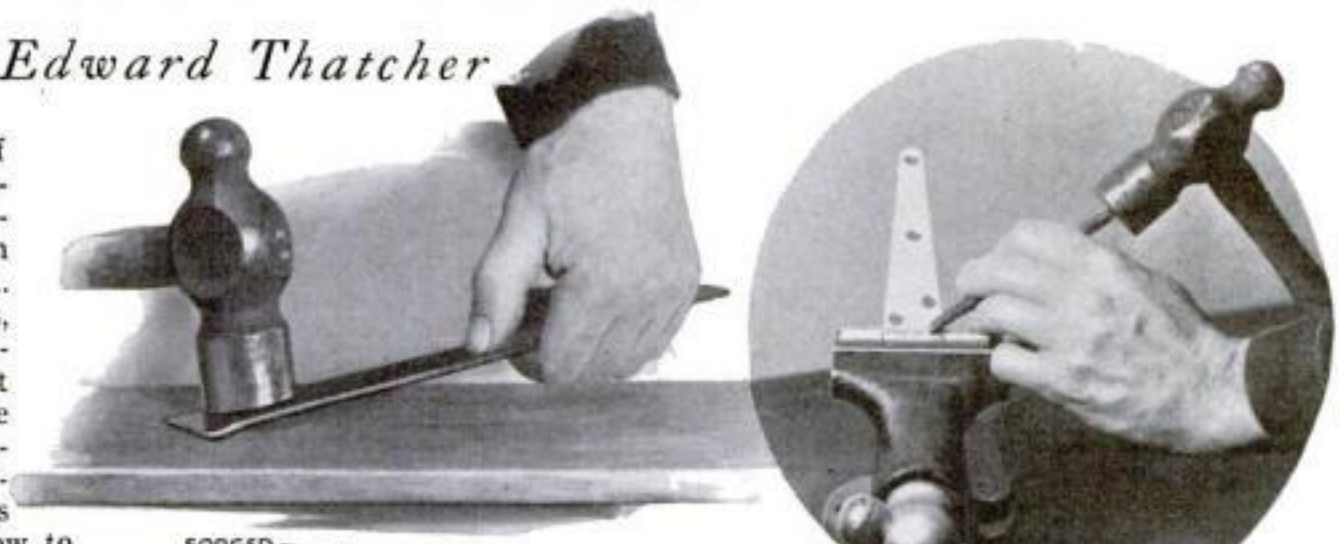
By Edward Thatcher

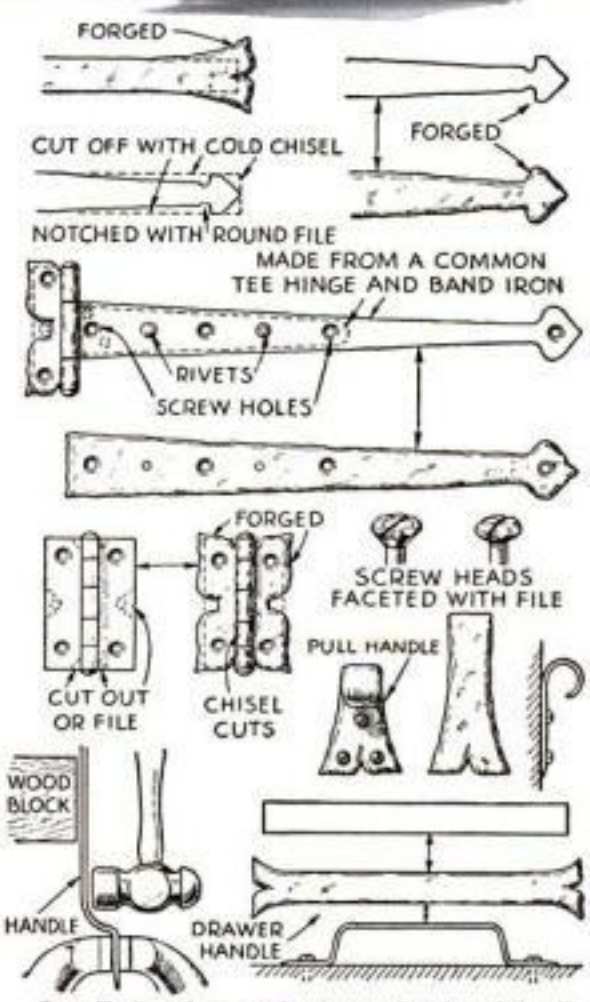
AFTER an excellent piece of furniture has been completed in the home workshop, it is often a problem to find suitable metal fittings for it. Common stock hinges and handles, useful as they are, may detract considerably from a carefully worked-out project, while hardware of suitable design and finish will add to its attractiveness. Such hardware, however, is relatively expensive. It is therefore an advantage to know how to convert mild steel hinges of the most inexpensive variety and ordinary band iron into fine-looking hardware suitable not only on furniture but on doors, closets, and cabinets.

Simple and beautiful designs may easily be worked out in keeping with the period in which the house is planned, such as Early American or Dutch Colonial. The larger sizes of stock hinges may be modified for use on heavy doors in the same way. The finished work closely resembles real forgings; indeed, you actually do cold forging of a very simple character.

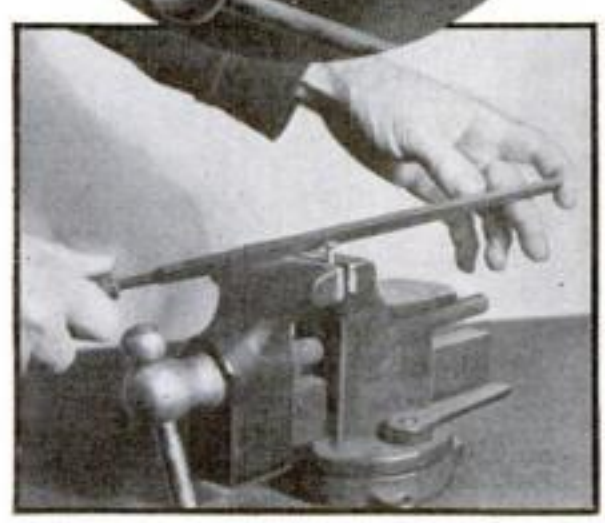
No forge is necessary for this work. Mild steel and band iron, which is really mild steel, can be worked cold because they will stand a lot of hammering before cracking. The metal may be annealed, if necessary, by heating it red hot and allowing it to cool in the air, but all the pieces illustrated were forged cold. The tools needed are generally found about the home shop—some sort of flat-faced anvil, the heavier the better; a good bench vise; a machinist's hammer; small and large cold chisels, very sharp; a few files, a hack saw, and a drill for drilling holes in mild steel.

Plain 3-in. butt hinges (or any other size) may be altered until they resemble





Detail drawings and, above, forging fishtail on end of strap, which is cut to length later



Screw heads are filed to give a handmade look. *In circle:* Chiseling a hinge barrel

those shown to the extreme right and left of the group at the top of the page, and many other simple designs in outline may be obtained in the same way on this type of hinge or on the other pieces in that illustration.

The two long strap hinges of the old fishtail and leaf or spearhead design shown in the center of the group were made from 3-in. T-hinges with a length of cold-forged band iron riveted to the strap. When *(Continued on page 89)*

Home Movies

HOW TO TAKE THEM LIKE A PROFESSIONAL

By Frederick D. Ryder, Jr.

Best results are obtained with the aid of a tripod; otherwise use a three-point support as at the left

I HAPPENED to be in a photo dealer's shop the other day when a man came in to get his first roll of 16-millimeter movie film which he'd left for processing. So anxious was he to see the result that he asked the clerk to project it for him then and there.

Ninety times out of a hundred, a man's first movie film is used on shots of his home and family. This one was no exception. The first scene opened with a corner of his house. Then, with a breath-taking swoop, the house darted across the screen, paused for a moment, and shot up in the air as the camera was swung down for a close-up of a near-by bird bath.

The next shot showed an open expanse of lawn with a woman and a child standing motionless and grinning into the lens. There followed similar shots of another child and various relatives. The last scene was a quick flash of the family dog being held in position, much against its will, by a hand and arm sticking into the picture area from one side. All through the film, the picture gyrated about on the screen in a way that nearly tore your eyes out.

This film showed at their very worst the three faults most often found in amateur movie making. The first is too rapid swinging of the camera in taking a panorama. The second is fire-hose operation. By this I mean holding the camera loosely and moving it constantly so that the resulting scenes, when projected on the screen, bob around and hop all over the lot. Spraying the scene with pictures in this way is just a waste of good film.

The third trouble is lack of picture planning and usually is due to a failure to grasp the essential difference between still photography and motion picture photography. A motion picture camera is designed to photograph objects in motion; you must, therefore, plan to get motion of some sort into every picture and do it in such a natural way that your subjects appear to be unaware that they are being filmed.

This applies, of course, to scenes that include people. In cases where the view itself is the object of interest, nature often supplies the needed movement in the shape of trees waving in the wind, waves breaking on the shore, and so on. Distant views can be planned to add life to the scene and also to let your picture show more territory.

A good rule in swinging the camera for a panorama is to take at least twenty seconds for a ninety-degree swing or proportionately less for a shorter one. That should be the maximum speed. Even slower is better if you can afford the extra film thus used. The same slow, steady motion should be used when you find it necessary to change the framing of the picture to follow the small movements of your subjects.

The best possible way to eliminate fire-hose operation is to use a good tripod fitted with a swinging and tilting head especially designed for motion picture work. Such an outfit is shown in one of the photographs. However, a tripod is a clumsy and cumbersome piece of apparatus to lug around on trips and hikes —the times when you are sure to want to take pictures.

A tripod is steady because it has three points of support, and the best hand-held position for a motion picture camera also has three points of support. Another photograph shows how to hold it this way. The arms, steadied by pressing against the sides, form two of the points, and the cheek is the third.

If you want *(Continued on page 85)*

Portrait Photos

made by foolproof three-light system

WHEN your camera is loaded with fresh film and you can't quite figure out what pictures you want to take, why not see what you can do with three lights in taking a portrait?

Here is an example and also a diagram showing how the three lights were arranged when it was taken. The method requires one light to be placed rather close to the subject, directly to one side and a little above the head. The second light is placed on about a forty-five degree line, level with the face and about twice as far away. The third light is placed behind, below, and slightly to one side of the head. You will find that this set-up will produce amazingly varied results just by having the subject turn his head to different angles.

Portraits equal in quality to this are easy to take if three lights are used as shown in the small diagram

If you remove the third or back light, the arrangement becomes quite conventional. Removing light No. 2 will produce a queer, dramatic effect with a portion of the front of the face in rather heavy shadow. Be sure to shield your lens from the direct rays of light No. 3. Skillful lighting will give a professional quality to your portraits.

★ BIG THRILLS FROM LITTLE NEGATIVES ★

KODAK HOME ENLARGER

...sturdy, accurate, simple to use. Takes all negatives up to 3¼ x 4¼ inches . . . enlarges up to 11x14. Ground glass in easel assures critical focus. Complete—with Kodar 98 mm. lens—$16.50.

BRING out *all* the beauty of your snapshots—enlarging does the trick. And now it's so easy—at home. With one of the new precision miniature cameras, you can get critically sharp negatives . . . with a simple darkroom outfit, you can do your own developing . . . then with the Home Enlarger, you can make beautiful large pictures you'll be proud to frame and keep.

These miniature Kodaks make negatives that enlarge beautifully

VOLLENDA

—*f*.3.5. . . . Its fast lens and 8-speed Compur shutter give you control of most picture situations. Folds compactly. Takes 16 pictures on vest pocket size film. Price, $33.50.

PUPILLE

...aristocrat among miniature cameras—with an ultra-fast *f*.2 lens... Compur shutter 1 to 1/300 second... eye-level finder . . . range finder and two filters. Takes 16 pictures each loading. In leather case, $90.

VOLLENDA

—*f*.4.5 . . . an inexpensive miniature camera . . . takes 16 pictures each loading. Three-speed Pronto shutter, *f*.4.5 anastigmat lens. Built-in self timer. Lets you take pictures of yourself. Price, $22.50.

KODAK DARKROOM OUTFIT, NO. 1

Taking pictures is only half the fun. Here, in one compact outfit, is everything you'll need for developing and printing. Includes safelight, trays, chemicals, graduate, stirring rod, developing clips, blotters, and Auto-Mask Printing Frame. In a durable, black fiber case, with instruction book—$8.75.

KODAK PANATOMIC FILM

...a fine-grain film for miniature cameras. Gives clear, brilliant negatives that yield big enlargements without showing graininess. Fully color-sensitive.

FREE . . . *Kodak catalog*

Eastman Kodak Company, Rochester, N. Y.
Gentlemen: Please send me a *free* copy of your catalog. I am particularly interested in more information about:

Kodak Home Enlarger ☐ Miniature Kodaks ☐
Kodak Darkroom Equipment ☐

Name_____

Street_____

City_____ State_____

P. S. 5-34

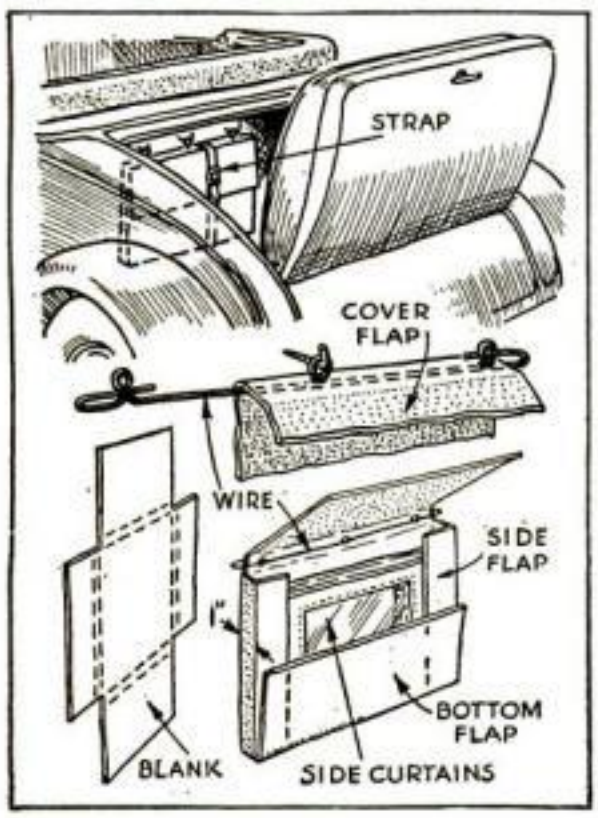
IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK

Useful Short Cuts *for MOTORISTS*

Suggestions for Quick Repairs and Handy Improvements on Cars Made by Our Readers

Sheet of orange cellophane over headlamp helps light pierce fog

LIVING in a section of the country where fogs are a frequent danger to those who venture out in a car, I devised a simple kink to get clear visibility even on the soupiest nights. Borrowing the idea from the modern neon beacon, I found that a smooth sheet of orange or light-red cellophane fastened over the lens of each head lamp with a strong rubber band colored the light just enough to allow it to pierce the fog. According to experts, the explanation is that light at the red end of the spectrum is less easily dispersed by fog or dust than is blue light.—W. R. J.



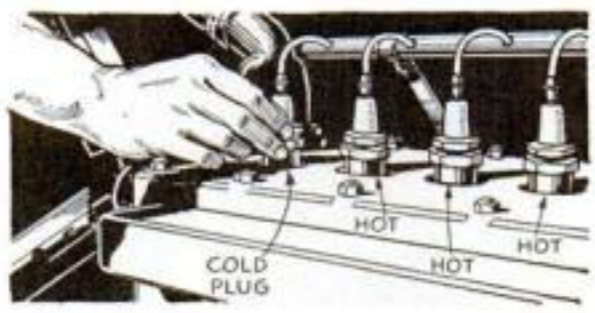
Side Curtain Case

WHEN I first became the owner of a small roadster, I spent considerable time trying to find some convenient place to stow away the side curtains when they were not in use. At first, I decided on the tool compartment under the front seat, but the tools scratched the celluloid "windows." Finally, I made the simple case shown in the illustration.

A piece of heavy yet flexible cardboard served as material for the case. It was cut cross-shaped, so that the flaps when folded back form an inch-thick envelope just wide enough and long enough to house the curtains.

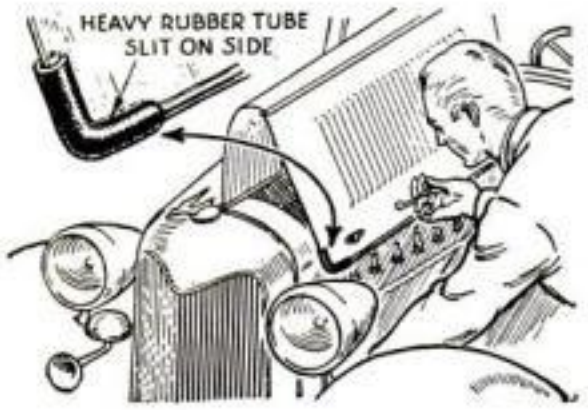
To mount the case, an ordinary wire coat hanger was first straightened and then reshaped to form three small loops. These project through three small holes cut in the upper edge of the case and hook over three hooks screwed into the wooden framework at the front of the rumble seat compartment. An ordinary slip-buckle strap is used to hold the case closed. If desired, the case can be given a coat of shellac and then painted.

When storing the curtains, all sides should be unfolded and the curtains laid flat in the case. Soft cardboard separators (shirt boards will serve) can be placed between the curtains to prevent them from rubbing together.—M. A. F.



Finding Faulty Plug

ALTHOUGH many tricks are used to locate a spark plug that is missing, the easiest way that the writer has found requires no tools or homemade testers. Simply start the motor when it is cold and allow it to run until it is warm. Then stop the motor and feel the base of each spark plug. The spark plug that has been missing will be colder than the rest.—E. J. N.



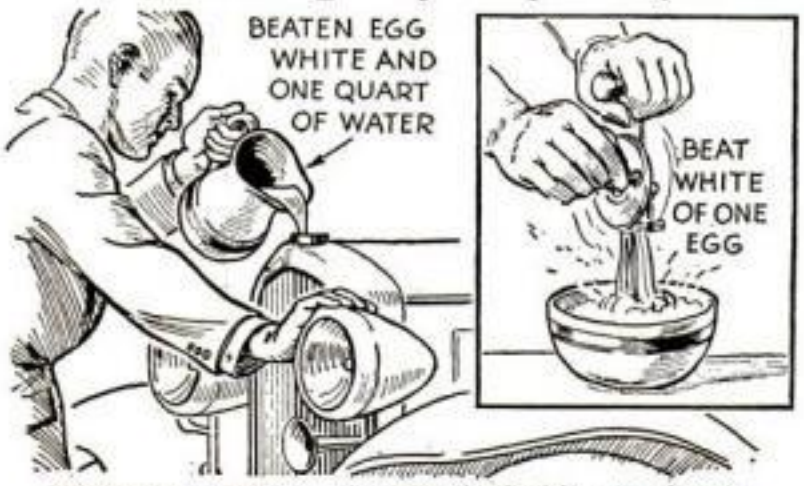
Guards for Hood

ON MANY modern cars, the head lamps are so placed that they receive scratches and dents from the front corners of the hood everytime it is raised or lowered. This can be prevented by providing these offending front corners with improvised bumpers made by splitting short lengths of heavy rubber tubing lengthwise and slipping them over the bead that edges the corners of most hoods. If desired, the tubing can be held rigidly in place with cement.—O. B.

Mending Radiator Hose

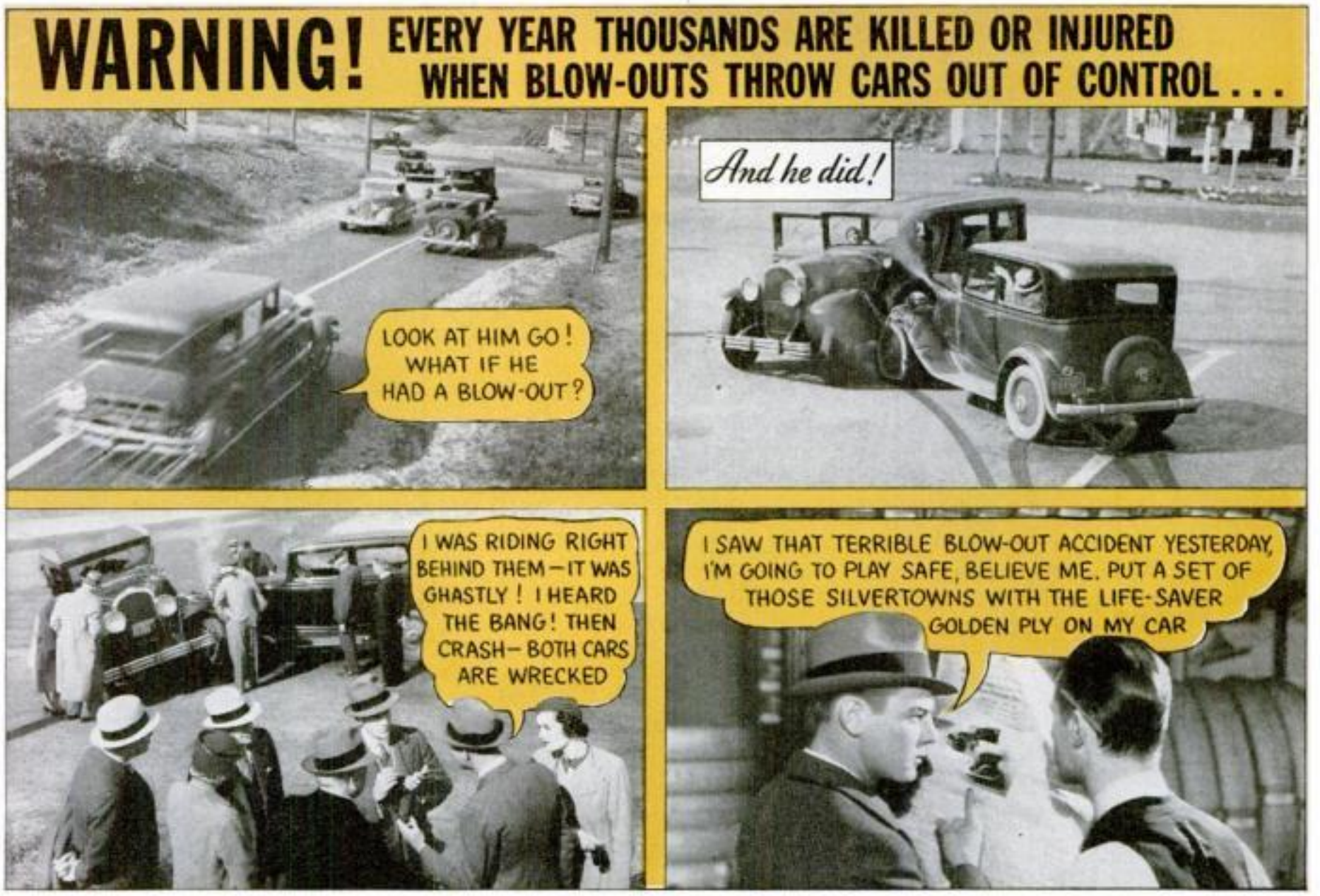
WHEN making an emergency repair on a leaky radiator hose, your first thought will be to use ordinary friction tape. However, if tape is used alone, the heat and water soon dissolve the adhesive. A better method is to use a long strip of rubber cut from an old inner tube. Wrap it around the hose in the manner shown. Then apply a layer of friction tape to hold it in place.—J. L.

Emergency Repair of Radiator Leaks



White of egg beaten to a froth is mixed with quart of water and poured in radiator. It coagulates and will stop a leak

ONE way to stop small leaks in a radiator core is to beat the white of one egg to a froth, mix it with one quart of water, and pour it into the radiator. The writer has found that as soon as the water gets hot, the mixture coagulates and will stop any small leaks that may exist without interfering with the normal circulation of the radiator and cooling system.—K. M.



GET THE TIRE WITH THE GOLDEN PLY

PROVED 3 TIMES SAFER FROM BLOW-OUTS

Get months of extra mileage, too...

ANYBODY that escapes injury from a wrecked car after having a blow-out is *lucky*. Because BANG!—when it does happen you might just as well be in a strait-jacket. You can't steer. You can't stop. You're headed for trouble.

Today's high speeds—40, 50 and 60—generate terrific heat inside your tire. Rubber and fabric separate. A blister forms . . . *inside the tire*, where you can't see it . . . and GROWS, until . . . BANG! A blow-out!

To protect you from blow-outs, every new Goodrich Safety Silvertown Tire has the Life-Saver Golden Ply.

This remarkable invention resists heat. Rubber and fabric don't separate. Thus blisters don't form inside the tire. The great, unseen cause of blow-outs is thus prevented by the Life-Saver Golden Ply. And here's proof.

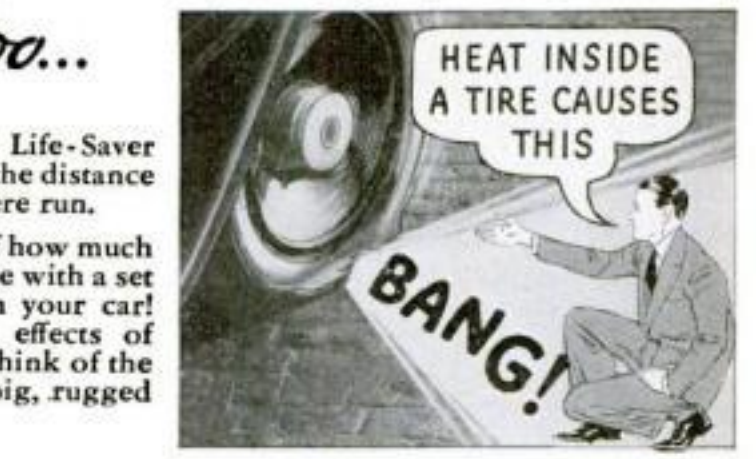
Racing daredevils tested the Golden Ply at breakneck speeds. On the world's fastest track. Gave it everything they had. Rubber got so hot it fairly smoked. *Not one blow-out.* Similar tires *without* the Life-Saver Golden Ply failed at one-third the distance the Golden Ply Silvertowns were run.

For *everyday driving*, think of how much safer you and your family will be with a set of Golden Ply Silvertowns on your car! And without the destructive effects of internal friction to weaken it, think of the months of extra mileage this big, rugged Silvertown will give you.

No extra cost!

Don't gamble when human lives are at stake. Play safe. Get a set of these new Goodrich Safety Silvertowns *now. Remember, they cost no more than other standard tires.*

FREE! Handsome emblem with red crystal reflector to protect you if your tail light goes out. Go to your Goodrich dealer, join Silvertown Safety League, and receive one FREE. Or send 10¢ (to cover packing and mailing) to Dept. 339, The B. F. Goodrich Rubber Co., Akron, O.



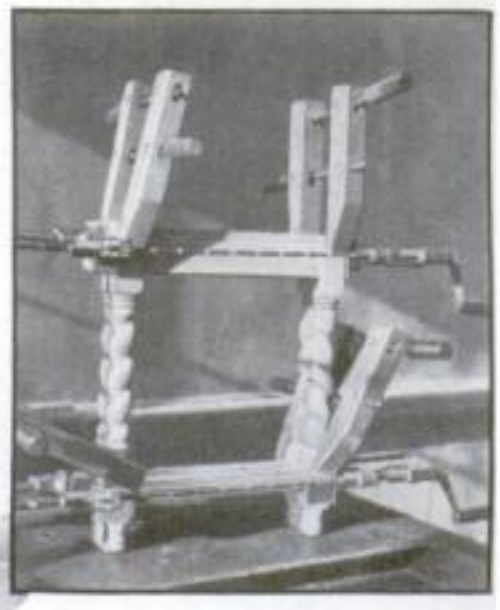
The NEW **Goodrich** *Safety* **Silvertown**
WITH LIFE-SAVER GOLDEN PLY

YOU CAN LEARN TO DO

Spiral Turning

by making this stand or coffee table

By Herman Hjorth



Two opposite sides are glued, clamped, and held together with hand screws to prevent twisting

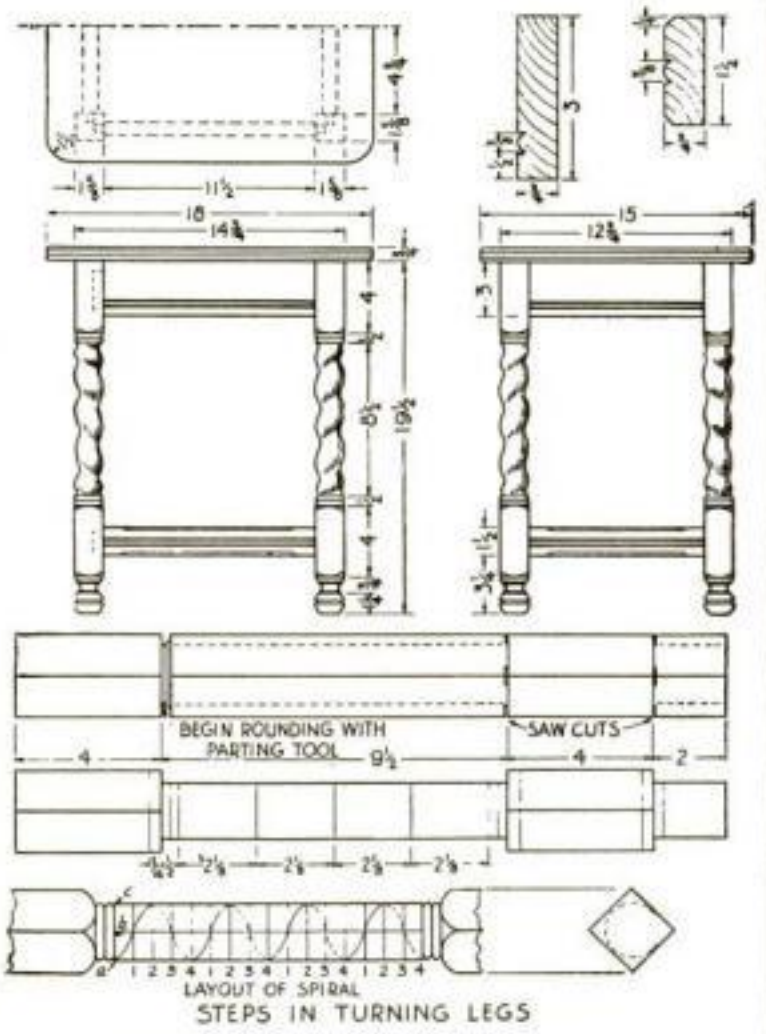
Staining the completed stand. By increasing the dimensions slightly, it can be used as a coffee table

SPIRAL legs on tables, chairs, cabinets, and other pieces of furniture are an effective form of decoration. Any woodworker can make them without previous practice at the very first attempt.

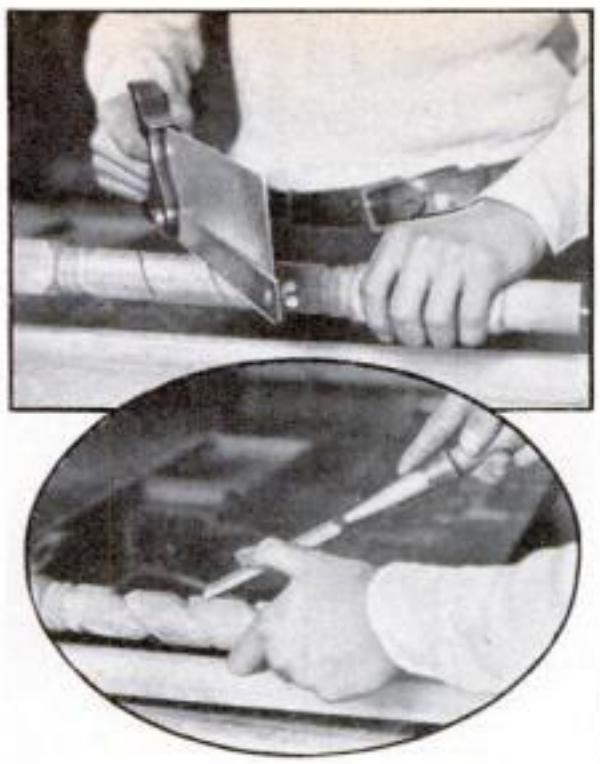
The legs of the stand shown in the accompanying drawing, like most spiral legs, have square parts. They must therefore be planed square before they are turned. Begin by planing two adjoining surfaces on each leg straight and square to each other. Then set a marking gage to 1⅝ in. and gage this distance from the squared sides on each leg. Plane the remaining two sides to the gage lines and saw the legs to length.

Place the legs side by side, lay out the square parts, and square lines around each leg at these points. Center each leg carefully in the lathe. Before beginning to turn, it is advisable to make a saw cut in each corner just outside the lines marking the square parts. Begin the rounding process by making one or two cuts with a parting tool at the saw cuts as shown in the first of the detail drawings. Finish the rounding with gouge and chisel as in the second detail drawing. The square corners are easily rounded with a ½-in. skew chisel, which is held flat on the tool rest as in the scraping method.

The spiral itself must be made by hand as it cannot be turned except on a special production lathe. It is laid out as follows: Divide the straight cylindrical piece into equal parts; in this case four is about the right number. Subdivide each of these parts into four equal parts and mark lines around the cylinder as shown in the third detail drawing. The cylinder is now also divided lengthwise into four equal parts. The division lines may be marked from the square edges of the legs. Begin drawing the spiral at line *a*, continue to where lines *b* and *1* intersect, then proceed to lines *c* and *2*, next to line *d* (opposite to *b*) and *3*, and then to lines *a* and *4*. Complete the remaining three turns in the same way.



Assembly drawings of the stand, details of the rails and stretchers, and three stages in making the legs



After the spirals have been cut with a back saw, the rough shaping is done with a chisel

Saw along the spiral line with a back saw to a depth of about ½ in.; then make V-cuts to the bottom of the saw cut with a chisel. Finish the bottom of the cut with a round file, and smooth the sides with a flat file and sandpaper. Do not finish the spiral too abruptly at the ends, but gradually taper it off as shown on the drawing of the stand. Note that the spiral runs in opposite directions on each pair of legs. During the carving, the leg may be supported on the lathe centers.

The rails and stretchers are now made. If so desired, they may be made a little larger than the dimensions given, so that the stand can be used as a coffee table. The lower edges of the rails may also be shaped instead of being planed straight. The beads shown on rails and stretchers are cut with a homemade tool called a scratch stock, previously described (P.S.M., Dec. '33, p. 80). The stopped chamfers on the stretchers are made with a chisel and a block plane or with a scratch stock.

The rails and stretchers may be joined to the legs either with dowels or with mortise and tenon joints.

Glue two opposite sides first. Place the clamps on the face side, and hand-screw the two glued sides together as shown in one of the photographs to prevent the clamps from twisting the legs out of square. When the glue is dry, the sides are joined with the remaining two rails and stretchers.

The top should be made from two or three narrower boards rather than from one wide one. It is preferable to start planing a glued-up top across the grain. Use a very sharp plane and take only light cuts. Smooth with a cabinet scraper along the grain, and finish with sandpaper.

The stand may be stained and finished with three or four coats of very thin shellac. Rub between coats with No. 2/0 or 3/0 steel wool. Apply a coat of wax over the last coat of shellac and let it dry over night. Polish by rubbing briskly with a soft cloth.

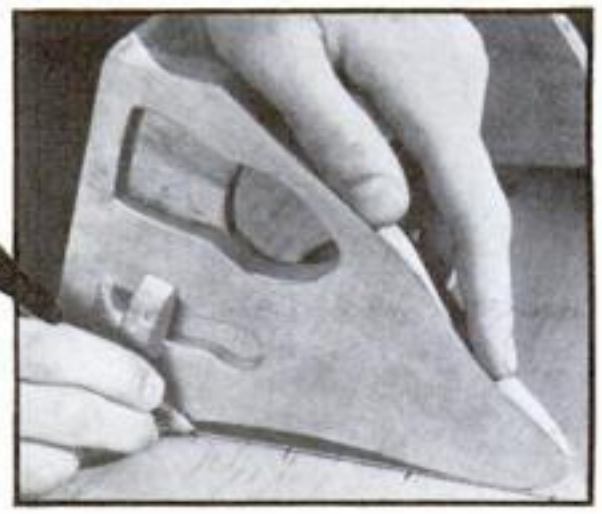
List of Materials

No. of Pieces	Description	T.	W.	L.
4	Legs	1⅝	1⅝	19½
2	Rails	¾	3	13
2	Rails	¾	3	11
2	Stretchers	¾	1½	13
2	Stretchers	¾	1½	11
1	Top	¾	15	18

NOTE: Dimensions are given in inches. These are finished sizes.

Quaint Bird House

FORMS COLORFUL GARDEN ORNAMENT



Front view of the bird house. The rear has only a single window and window box. *Right:* Marking position of the screws on a roof board

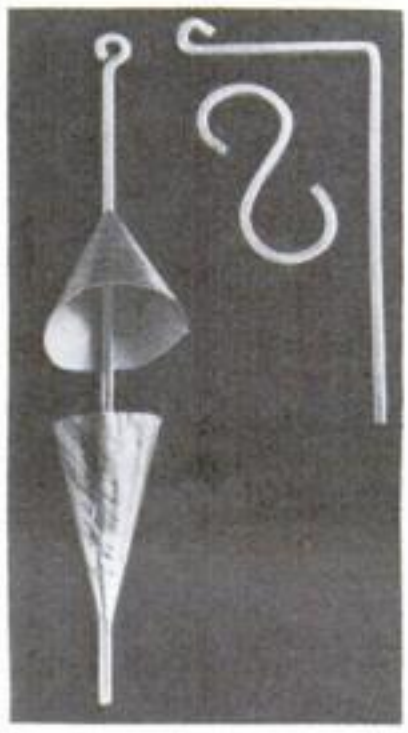
By Morton Bartlett

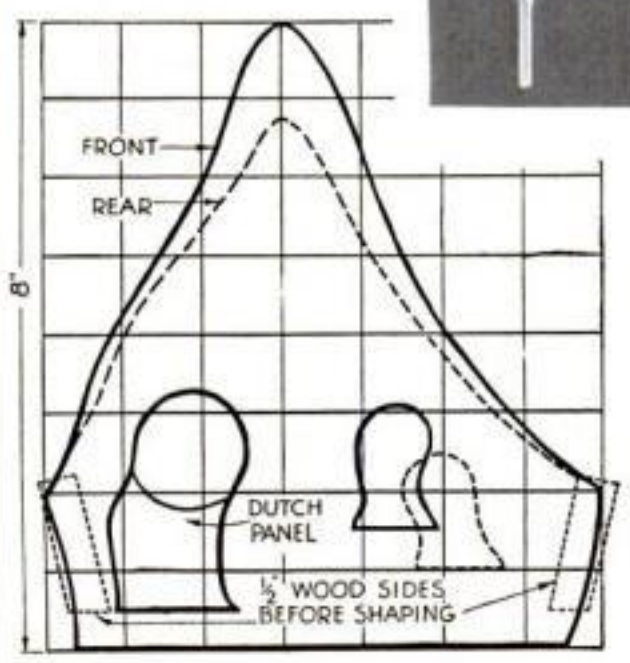
THIS brilliant, gnomelike bird house will add color to any garden. What is more, it will attract a family of birds and be lived in by them in spite of—or possibly because of—its scarlet roof, its window boxes, and its painted flowers.

The main structure of the house is of ½-in. white pine. The front and back ends are first jig-sawed out. They are 8 and 6¾ in. high respectively, and 6¼ in. across the bottom. At the widest point, where they flare out, the ends are 7 in.

The recessed Dutch door panel is made by placing the hole for the door on a piece of ¼-in. wood and tracing the outline. The recessed windows are made the same way on ¼-in. wood which has had grooves cut across the grain with a sharp chisel to simulate blinds. These parts are cut a little larger and trimmed down so they will fit very snugly. They are forced into place, flush with the inside, to give a recessed effect from the outside as shown.

The ends are screwed to a 6½ by 7 in. baseboard. The sides, 1¾ by 7 in., are next nailed in place with 1¼-in. wire brads. The convex side is shaped with a plane, and the concave with a gouge. Finish with coarse sandpaper. The front end is beveled around the top to match the slope of the roof toward the rear. The window boxes are pieces of ½-in. wood jig-sawed out a little crooked and tacked in place under the windows.





How to lay out the front and back. *Above:* The lantern must be soldered so it will not swing

The curved roof is made from ¼ in. white pine, preferably green. Two pieces 11 by 12 in. will be needed, and it would be well to have a couple of extra pieces in case any split beyond redemption.

Lay one piece for the chimney side of the roof on the bench top, and place the house on it in the approximately correct position. Draw pencil lines guided by the outside of the two ends, as shown in one of the photographs, and indicate the centers of the concave places both on the house and on the roof board. Also mark one of two other strategic places for screws. Removing the house, drill holes ¼ in. inside the lines where marked. The holes should be not quite as large as the shank of a 1½-in. No. 9 (3/16-in.) wood screw. Drill holes into the ends of the house with a No. 52 drill to receive the screws.

Screws are put through the holes in roof as far as they will go and started in the house, but without exerting dangerous pressure. With one side of the roof on, let steam from a boiling kettle blow on it; or the boiling water itself may be poured on. Tighten the screws bit by bit, working first one then another. Too much speed will result in splitting the roof. The screws may be helped by pressing on the roof with gloved hands as they are tightened.

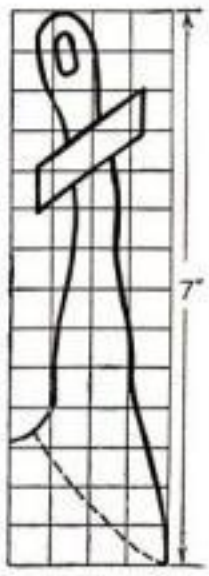
The chimney, carved from wood ⅞ by 2 in., is screwed from underneath before putting on the other side of the roof. Fitting the roof at the peak when both sides have been steamed in place is a matter of whittling and joining in which the worker must use his individual

skill. The final step is to cut the outline of the roof with the fret-saw blade at a 90-deg. angle to the handle. The house is then put in a warm place for two or three days to dry out thoroughly. After this, cracks and screw holes may be concealed and the angles at the overhanging peak and the base of the chimney rounded out with wood substitute, and the whole finished with fine sandpaper.

Painting is done with outside colors. The roof is red; the house, white; door, yellow; blinds, green; window boxes, gray; chimney, red with a white or terra cotta pot. The flowers may be painted with artists' colors and renewed each year. A little black may be used sparingly around sashes and to represent hinges.

The lantern, which is added last, consists of square radio bus wire and two cones of thin copper. It is secured to the house with small staples. The wire is painted black, and the lantern decorated as you like.

The house should be erected on a pole 8 to 10 ft. above the ground in a place where people do not pass too frequently. The fresh smell of paint may keep the birds away for awhile, but in the end they will come to it. I have had both bluebirds and swallows in houses of this construction.



Cut the chimney to this pattern from a ⅞ by 2 by 7 in. piece

Dimensions may be modified to suit the particular birds you wish to attract. For a tabulation of suitable sizes, see P.S.M., Apr. '34, p. 93.

SIMPLE DRILLING JIG FOR MODEL DEADEYES

DEADEYES for ship models or any other small round objects can be held securely for drilling in a clamp made as shown in the drawings above. The deadeye is placed between the two wooden jaws, the tapered ends of which are then pushed between two blocks screwed to a board or to the bench top. A light tap on the rounded ends of the jaws will make them grip the deadeye as tightly as necessary. To guide the drill, a small metal cup with properly spaced holes in it may be dropped over the deadeye.—P. A. SYRACUSE.

CUTLERY!

Who called it *cut*lery?

CUTLERY means knives and shears that *cut*. The dictionary has no word for dull ones which only chew and tear. Look up words like chop, gash, hack, hew, sunder and chew. They describe the cutlery in the average home.

A Norton Pike stone, or household grinder will put the cut back into your cutlery. The butcher uses them to sharpen his knives and cleavers. The woodsman uses them for his axe. Carpenters, cabinet makers and master machinists use Norton Pike Oilstones to put hard, supersharp edges on fine steel tools. Expert workmen know when to use an India *Oilstone* or that aristocrat of all stones, the Hard Arkansas.

All the Knacks of Experts

How to sharpen different tools according to their shape and purpose is told and pictured in the Norton Pike free book. What a man doesn't know is often hard to imagine. Why guess about this book. Write today before you forget.

NORTON PIKE

Use what Experts use

Sharpening Specialties

BEHR-MANNING CORP.,
U. S. Sales Representatives
Dept. W, Troy, N. Y.

Please send me the Norton Pike book "How to Sharpen." I'm *sharp* enough to ask for it, since it's FREE.

Name .....

Address .....

My dealer is .....

OUR WELL-TESTED

BLUEPRINTS

A matchless FLYING MODEL

IF YOU would like to try your hand at building a flying airplane model with a 4-ft. wing spread, get our Blueprints Nos. 141-142-143 for the famous *Winnie Mae*. It is far superior from an aerodynamic standpoint to most models. With detailed instructions, 75 cents.

TO AID you in your home workshop, POPULAR SCIENCE MONTHLY offers blueprints with working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

Many other blueprints are available. Send a stamped and addressed envelope for a complete list.

FLYING AIRPLANE MODELS

Bremen (Junkers, 3-ft.), *89-90*	$ .50
Nieuport XVII, 29-in., *180-181*	.50
Rise-off Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (record 12½ min.), *102*	.25
S. E. 5a World War Plane, 30-in., *168-169*	.50
Single Stick, Tractor, 30-in., *82*	.25
Tractor (record flight 6,024 ft.), *104*	.25
Twin Pusher, Racing, 35-in., *86*	.25
Winnie Mae, 4-ft., *141-142-143*	.75

BOATS

Canoe, Sailing Outfit, *25*	.25
*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R*	1.00
*Duck Boat, Folding, *170-R*	.50
*Outboard Racer, 11½-ft., 156 lb., *128-129-R*	.75
*Outboard Racer, 10 ft. 4 in., 114 lb., *211-212*	.50
*Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
Marconi Rig with Jib for Above, *133A*	.25
*13-ft. Rowboat-Motorboat, *147-R*	.50
*14½-ft. Rowboat-Motorboat, *148-R*	.50
*16-ft. Rowboat-Motorboat, *149-R*	.50
Stern Drive Installation (when used with rowboat-motorboat), *150*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

FURNITURE

Bookcase, Simple, *37*	.25
Bookshelf and Book Ends, Modernistic, *100*	.25
Bookstand, Modernistic, *88*	.25
Chests, Treasure, *78*	.25
Desk, Colonial, *21*	.25
End Table, Magazine, *68*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Pier Cabinet and Corner Shelves, *77*	.25
Screens, Modernistic Folding, *91*	.25

Insure Your Success

Sewing Cabinets, Two, *31*	.25
Shelves and Lamp, Modernistic, *93*	.25
Smoking Cabinet, *2*	.25
Stand, Low Modernistic, *100*	.25
Table, Gate-Leg, *24*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, Oak (top 20 by 24 in.) *140*	.25
Tea Wagon, *13*	.25

RADIO SETS

All-Wave Portable Receiver (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Five-Tube Short Wave Set (A.C. or D.C.), *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 6}

Bark, Scenic Half-Model (13½-in.), *108*	.25
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
Covered Wagon (23½-in.), *118-119-120-R*	1.00
Cruiser *Indianapolis* (12 in. long), *216*	.25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Galleon, Spanish Treasure (24-in.), *46-47*	.50
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222*	1.25
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Manhattan* (12 in. long), *204*	.25
Pirate Galley or Felucca (20-in.), *44-45-R*	.75
Roman Galley (19-in.), *138-139-R*	.75
Sails—Square and Fore-and-Aft for Whaler *Wanderer* or any Model, *185-186*	.50
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Schooner — *Bluenose* (17½-in.), *110-111-112-R*	1.00
Sedan Chair, Queen's (12-in.), *123-124*	.50
Stagecoach (20½-in.), *115-116-117-R*	1.00
Stagecoach (Cody), with horses (coach body 13 in. long), *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Viking Ship (20½-in.), *61-62-R*	.75
Weather Vane, Ship Model (30-in.), *66*	.25
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

MISCELLANEOUS

Bird-House Patterns (full size), *P-1-2-3*	.25
Doll's House, Colonial, *72*	.25
Log Cabin (three rooms), *134-R*	.50
Microscope Kit, Portable, *220*	.25
Perpetual Star Chart, *214*	.25
Tool Cabinet, Bench Hook, etc., *30*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25
Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....

Patterns for .....

Reprints alone for.....

I am inclosing.....dollars.....cents

Name .....

Street .....

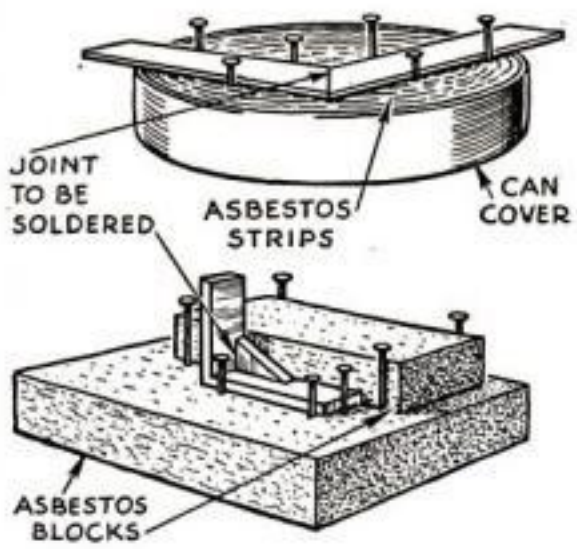
City and State.....

Please print your name and address clearly.

This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS

SOLDERING PADS MADE OF SHEET ASBESTOS

FOR those who use a jeweler's lamp and blowpipe in soldering small articles, these asbestos pads will prove helpful. The first one is a circular pad made from asbestos strips, wound tightly and pressed into a can cover. The pad should be thick enough so that the ordinary pins used in holding the

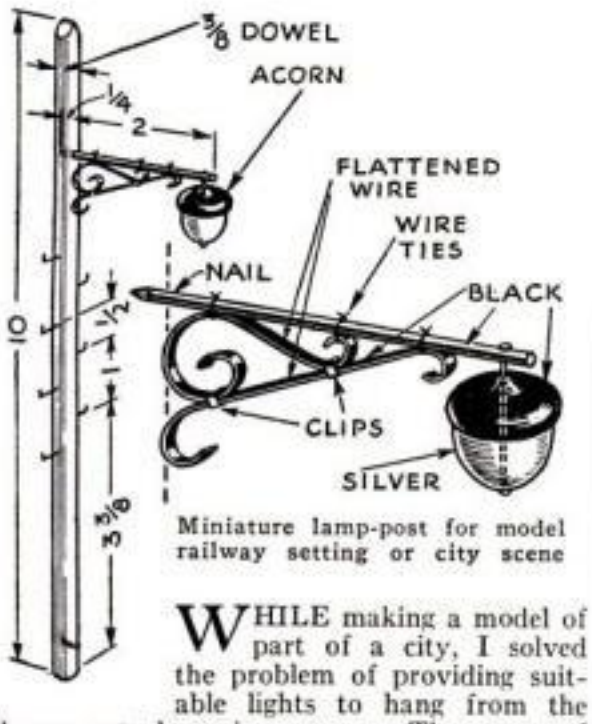


The first pad is a coil of asbestos strips; the second is made of sheets pasted together

work may be inserted their entire length. If the strips are not cut evenly, the pad may be sandpapered down to produce a level surface flush with the edge of the cover.

The second type of pad consists of two rectangular blocks built up of sheets of asbestos, which are held together with common flour-and-water paste. Other forms may be made for special soldering jobs, but the pads shown, when used in combination, will take care of all ordinary jobs.—J. W. CLEMENT.

ACORNS SERVE AS LAMPS IN MODEL OF A CITY



Miniature lamp-post for model railway setting or city scene

WHILE making a model of part of a city, I solved the problem of providing suitable lights to hang from the lamp-posts by using acorns. The acorn of the red oak is best suited for this purpose.

The pole itself is a ½- or ⅜-in. dowel 10 in. long. The bracket is a 2¼-in. nail and two pieces of heavy wire that have been flattened out. The flattened pieces are curved to the desired shape and fastened together with small clips made of wire. The acorn is fastened to the bracket by a wire running through its center. The foot rests are small pieces of heavy wire bent at the end and set in at 1-in. intervals.

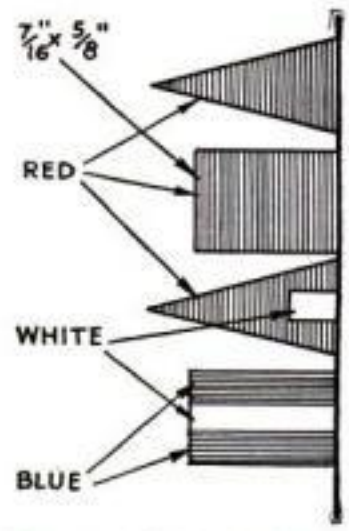
The bracket and the cup of the acorn are painted black, and the lower part of the acorn is painted silver.—J. A. MAROTTA.

WE FINISH THE

HARTFORD Model

and hoist her battle flags

By *Captain* E. *Armitage* M*cCann*



The signal for beginning battle—run up at mizzen

This model shows how the *Hartford* looked early in the Civil War when she was Admiral Farragut's flagship

How a mast top and the topmast shrouds appear in the completed model. The maze of rigging will become clearer when the various detail drawings are studied

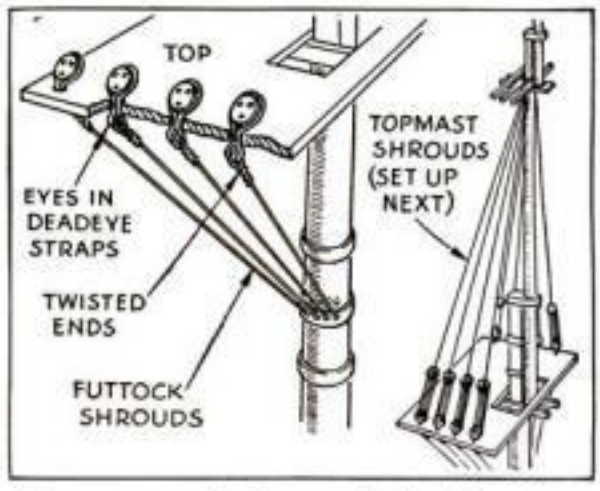
OUR ⅛-in. scale model of Admiral Farragut's famous sloop-of-war *Hartford* is now nearing completion. This is the last of a series of five articles which began in the January issue.

Our endeavor, after much research, is to make her as she was during the height of her fame in the early 1860's. There is not room to describe every last detail of the rigging, but a few hints should be sufficient if the previously published rigging plan and the various photographs and sketches are carefully studied.

Four thicknesses of black or dark brown cord are used for the standing rigging. These grade from cord about as thick as No. 20 wire for the lower shrouds, stays, and topmast backstays to the thickness of No. 30 wire for the royal backstays and stays. Hard-laid linen cord should be used. The running rigging (that leading through blocks) is natural flax color or light brown ranging in thickness from No. 22 to 34. The latter is equal to No. 70 thread.

It is wise to make the caps and ship the topmasts before setting up the lower rigging; then the bights will not be in the way. Each cap should be made to fit its mast, so that the masts will be parallel at the doublings. Fiber is the best material, but celluloid or hardwood can be used. Across them lies a curved piece of metal with holes for the topping lifts, to keep them clear of the topmast shrouds.

To get the upper deadeyes level, turn in the forward deadeye (starboard side); reeve the



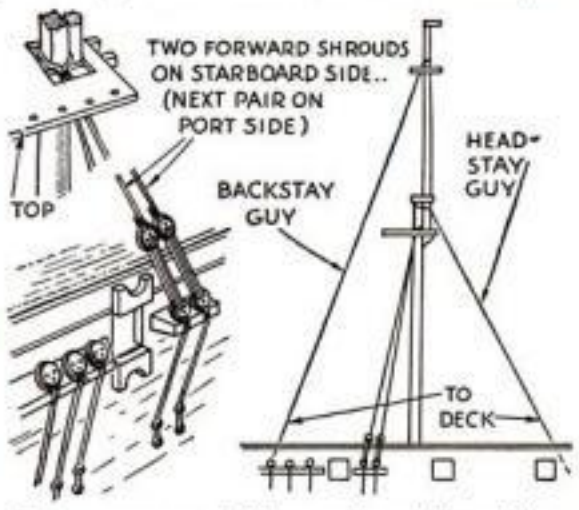
How topmast deadeyes and shrouds are set up. The futtock shrouds are of soft copper wire

In this unusual view of the model, the rigging seems to tower above the graceful hull

lanyard, bringing the deadeye almost down to position; then take the cord around the mast and down the same side. Hold the second deadeye in its approximate position, take a hitch above it with the seizing thread; try for height with the tweezers and, when correct, seize in position and bring both lanyards down together. The next pair goes to port, and so on. Before setting up the rigging, I hitch a temporary stay and backstays to the masthead and bring them down tight to the hull to hold the mast in position. At the lowermast the stay goes above the shrouds; in every position above that, the stay goes on first.

The futtock shrouds are next, or they may be put on first. I made these of soft copper wire, fastening them to the futtock band, then taking the ends through the straps of the deadeyes, which project through the tops, and twisting them underneath.

The topmast shrouds should be set up next with a grade thinner cord and 5/32-in. deadeyes. Then come the topmast stays and backstays. The fore-topmast stay is double. It leads through the bees on the bowsprit and is turned back through bolts in the beak and seized. The inner jib stay goes through the jib boom, back under a cleat on the dolphin



Temporary guys hold masts in position while the shrouds are fastened, one pair at a time

striker, and to a bolt in the bow. The fore-topgallant and royal stays are similarly set up. It is wise to leave all these upper stays until later, because the jib boom is very much in the way. The main and mizzen topmast stays come down through eyes put into, or strapped around, the lower mastheads, about ½ in. above the tops and are seized to bolts in the tops.

At this point it is wise to put on the ratlines (steps). The correct distance apart is hardly more than ⅛ in., but I spaced mine 3/16 in., which looks well.

Next ship the *(Continued on page 96)*

A Money-Saving Way to

KEEP YOUR Paintbrushes Clean

The brushes are wiped with crumpled newspapers and then hung in a can of water until you are ready to clean them thoroughly

By H. G. Weaver

ONE of the biggest problems in the home workshop is keeping paint and laquer brushes in the proper condition. While conventional methods of cleaning are effective, the expense is beyond reason in relation to the typical paint jobs of the home workshop, where in many instances more material will be required to clean the brush than has been used to paint the object.

Here is a system that has solved the problem for me. It may not be good chemistry and perhaps the brushes won't last so long, but I have been using it almost a year and it saves much time. I no longer dread to be commissioned by my small son to paint a dozen blocks in as many different colors.

Five cans are required. One is for water, another for gasoline or naphtha, and the third for wood alcohol. The fourth is left empty as a vessel for doing the cleaning, and the fifth is used for jellied soap, made by filling the can about one third full of soap flakes and then filling it with water and stirring. The can of water is used for keeping brushes soft until you are ready to clean them.

To keep brushes from resting on the bristles, clip a spring type of clothespin on the brush, then put a 10- or 12-penny nail through the coil spring in the clip. This makes it possible to hang the clip and brush on the edge of a can as illustrated.

After using a brush, take a handful of crumpled newspapers and remove the excess paint or lacquer from the bristles. If you are not quite ready to clean it, clip it with a clothespin and hang it in the can of water. Brushes should not be left long in water, but a short immersion does no harm.

The second step is to pour a little gasoline or naphtha in the empty can and wash the brush in it, if oil paint, varnish, or enamel has been used. In the case of shellac or lacquer, pour wood alcohol in the empty can and work the brush around in it. Although wood alcohol is not a perfect solvent for lacquer, I find it works satisfactorily when used while the brushes are still wet. It is well to rinse the brush in hot water before and after this second step.

The third step in either case is to work the brush thoroughly in the can of soap jelly. Then wash in hot water.

The final step before putting the brush away (unless it is a lacquer brush) is to oil the base of the bristles with ordinary cylinder oil. This tends to dissolve and soften any remaining vestige of paint and insures pliability where the bristles are most likely to become brittle and break off. If brushes are used frequently, the oil should be applied sparingly, but if they are not to be used for a long time, it may be used more freely. It will evaporate over a period of time. I treat my lacquer brushes in the same way, but hesitate to recommend it because even a trace of oil may cause difficulty when using lacquer.

Oiling bristles at base to keep them flexible

Here's where the economy comes in: The gasoline, naphtha, or alcohol, as the case may be, is poured back into the storage can from which it came and the can covered and put away. The pigment settles at the bottom, and the cleaning liquid may be poured off and used over and over again.

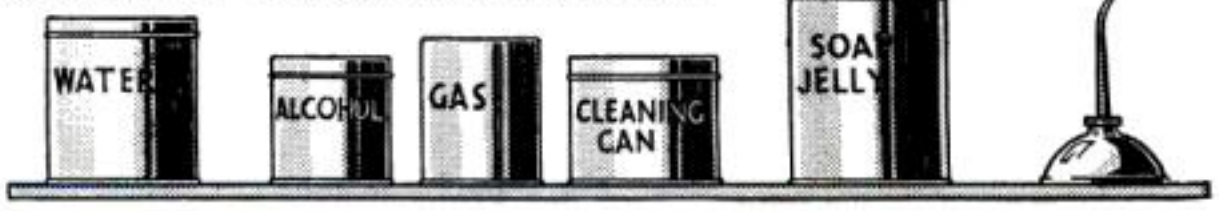
On small touch-up jobs where the soiling of a brush is hardly worth while, I have found it convenient to use a piece of cotton twisted on the end of a small stick. This can be thrown away after using.

1 Brushes are kept in water until convenient to go ahead with the other steps

2 Wood alcohol is used for cleaning shellac and lacquer brushes, and gasoline or naphtha for paint, varnish, and enamel brushes. The cleaning is done in an extra can

3 The brushes are washed in soap jelly and then in hot water

4 A few drops of cylinder oil are applied on the bristles



HOME MOVIES AND HOW TO TAKE THEM

(Continued from page 72)

to become so expert at holding that your friends will think you use a tripod, practice this position till you can line up the finder on a spot on the wall and run the camera (without film, of course) for ten or fifteen seconds without the spot dancing around to any noticeable extent.

In essence, the idea is to convert yourself as far as possible into a rigid camera-holding fixture from the waist up and move the camera as little as possible, and then only by swinging the whole body at the waist.

REMEMBER, too, that the use of a long-focus lens greatly aggravates whatever wabble there may be in the camera support. With care you can get good results using a 2-in. lens and holding the camera as suggested, but if you use a 3- or 4-in. lens, you are sure to get jumpy pictures. A tripod or a very firm support for your elbows is absolutely needed with such long-focus lenses.

The third of the most common faults in home movie making—lack of planning—is easily remedied. Just figure out ahead of time what you want your subjects to do so as to get natural action into the picture.

Suppose, for example, that you wish to take a shot of your son and his little playmate. Instead of lining them up in front of the camera and photographing them while they grin sheepishly at the lens, why not have them walk up the street together, talk a moment or two with each other on the front doorstep, and then say goodby as your son's little friend walks out of the picture? This gives you a chance for a long shot as they approach and for a close-up on the steps. It will save film and insure better results if you have the children rehearse the procedure at least once while you study the possibilities through the camera's finder.

Give them strict instructions not to look at the camera or to pay any attention to what you are doing. Even if they violate this—and it's one of the most important rules of moviedom—you are certain of a more interesting result than you'll get out of any number of feet of film taken while the two stand and grin at you.

It goes without saying that the best shots you are likely to get of either children or grown-ups are those taken when your subjects are completely unaware that a camera is trained on them.

LONG-FOCUS lenses often are an invaluable aid in filming such shots because they make it possible to get close-ups from a considerable distance. For instance, suppose the children are playing together in a neighbor's yard or across the street, say 60 ft. away. It would hardly be worth while to film them with the 1-in. lens that is regular equipment on all 16-millimeter cameras. They would appear too small on the screen. A 2-in. lens would give you the same effect as though you were only 30 ft. away, a 3-in. lens would be equivalent to walking up to within 20 ft. of them, and a 4-in. lens would cut the apparent distance down to 15 ft.

In a future article, Mr. Ryder will explain the tricks of adding titles to your films and show you how easy and inexpensive it is to give this professional touch to your work. If you do not own a motion picture outfit but intend to buy one, look up his previous article "Getting a Start in Home Movies" (P. S. M., Oct. '32, p. 74).

The winter series of photographic contests has revealed a distinct improvement in the work of our readers. For a list of the winners in the January contest, which was the third in the series, see page 95.

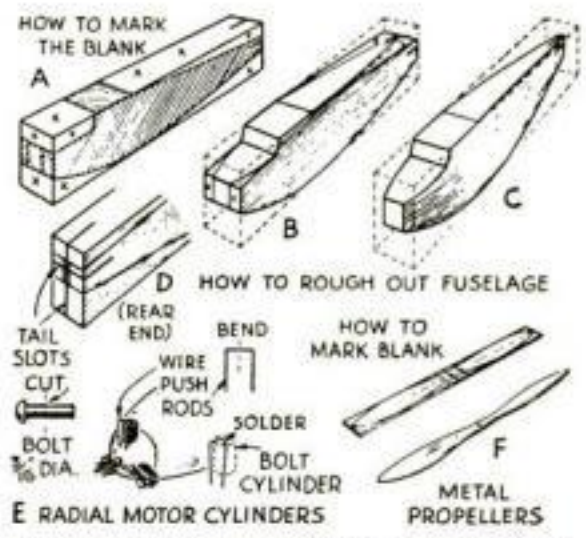
HINTS ON BUILDING

Solid Model Planes

By *Donald W. Clark*

BUILDING small scale model airplanes of the whittled or solid type has become such a universal hobby among boys that the following hints are offered to help them get more accurate and realistic results. These methods can be used with airplane designs and construction kits of innumerable kinds, but are especially intended for models such as have been described in our own long series. Some of the ideas have been used in past designs, but are shown again for the benefit of those who have not constructed those particular models.

Almost any shape of fuselage can be roughed out by using the simple method illustrated above. Cut and plane the blank to the overall dimensions and mark as shown at *A*. Saw away the sections marked *x*, then mark the top plan lines and cut away the remaining excess wood, as at *B*. At this stage your fuselage will resemble the one shown at *C*. It is then easy to shape the cowl and round off the corners. The tail slots should be sawed as at *D*, before the roughing out is started.



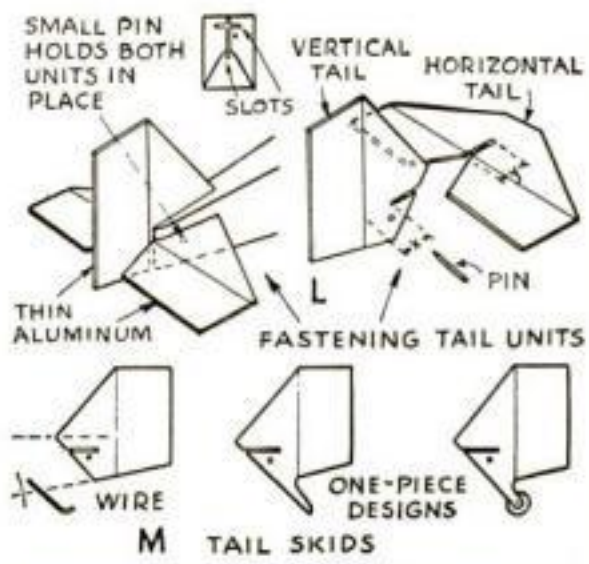
Steps in cutting out a fuselage, and methods of making the motor cylinders and propellers

Cylinders of an air-cooled radial motor can be represented with pieces of bolts glued or cemented into holes in the fuselage as at *E*.

The propeller may be cut from thin aluminum as at *F*. Clamp the blank in a vise and file to shape. Polish with fine emery cloth.

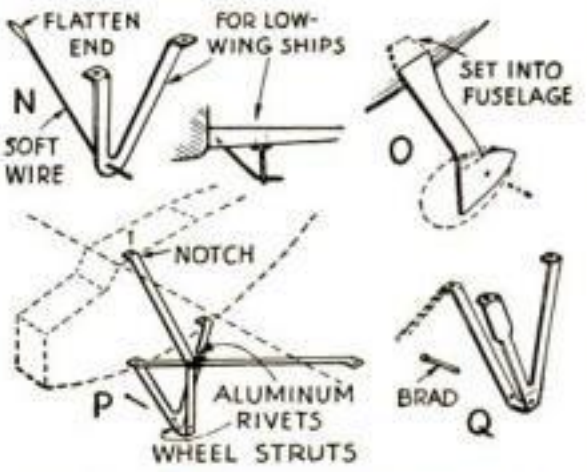
Wing struts are made of either wood or bamboo and glued in place or cut from thin metal, as shown at *G*, and fastened with small nails or set into slots in the wings or fuselage. The sketch at the left of *G* shows how the pieces can be flattened between two blocks of metal. File the rough edges.

How suitable wing struts are cut from thin metal, and the way to work out wing shapes



Holding the slotted tail units in place with a single pin, and three styles of tail skids

Wings can be made easily of white pine by marking the profile on each end of the blank (*H*) and planing down to the line. Next round the tips (*J*) with knife and sandpaper. Finish by rounding the end to look like *K*. Wire pins or nails will hold the lower wings to the fuselage.



Wheel struts for low-wing transports, small racers, high-wing ships, and fighting planes

An easy and practical way to secure the aluminum or fiber tail units to the fuselage is the slot-pin method shown at *L*. Two slots sawed in the tail end take the metal parts, which are held tightly with a small metal pin. The two dimensions marked *x* and *y* should be exactly the same, no matter how far forward the tail parts extend.

A simple way to represent wheels and pants

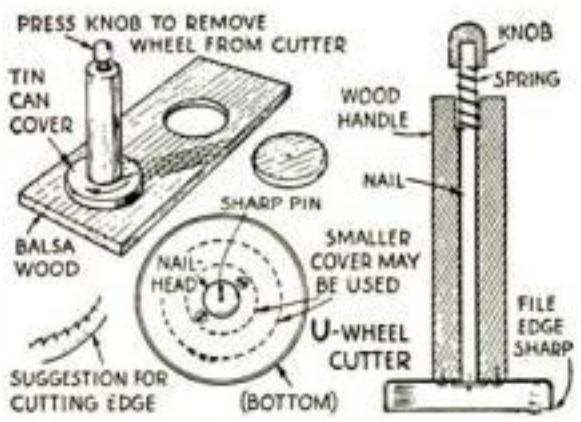
Shown at *M* are three easy ways to make tail supports. The first is merely a bent wire

set into a hole in the wood. The second drawing shows how to make the skid and rudder in one piece. The third is similar to the second, but a circle is shaped on the lower end to represent a wheel. Hinge lines, hinges, and names or numbers can be put on the painted surface with a pen and India ink. A fine-toothed hack-saw blade is best for cutting slots in wood and metal parts.

The wheel-strut sketches show four simple ways to represent the popular split type landing gear. Thin metal is used in the ones shown, and the strut ends are bent and have holes which take small nails. *N* is intended for low-wing transport planes, *O* for small racers, *P* for high-wing monoplanes, and *Q* for army and navy planes. The latter is suitable for any type of airplane of standard size and can be made of two pieces of thin metal. The sketch shows only the left half of the gear.

Wheel pants can be made easily of white pine or balsa wood. Draw the profile on a piece of wood thick enough to allow for both pants. Shape to the line, saw in two as shown at *R*, and round the edges with a knife and sandpaper. Cut a single wheel in two and glue the halves to the bottom of the pants as at *S*. The way the assembly is attached to the strut is shown at *T*.

The drawings at *U* show how to make a wheel cutter. The design was suggested by Don Couse. The wood handle has a hole drilled through its center to take a large nail, the upper end of which has a coil spring and a wood knob that fits tight. There is a recess for the spring. A small tin cover from an adhesive-tape or bouillon-cube can serves as a cutter and is held on the handle with two



With this homemade cutter, small wheels can quickly be made from thin, soft balsa

screws. By removing these screws, the knob, and the spring and sliding out the nail, a different sized cutter or cover may be attached. A centering pin inserted in the nail head as shown makes it easy to cut the blank from the reverse side also. Place the cutter on the balsa wood, push down the knob, and press down on the handle while turning it back and forth in short strokes.

BROKEN FILE KEEPS WRINGER CLAMPS FROM SLIPPING

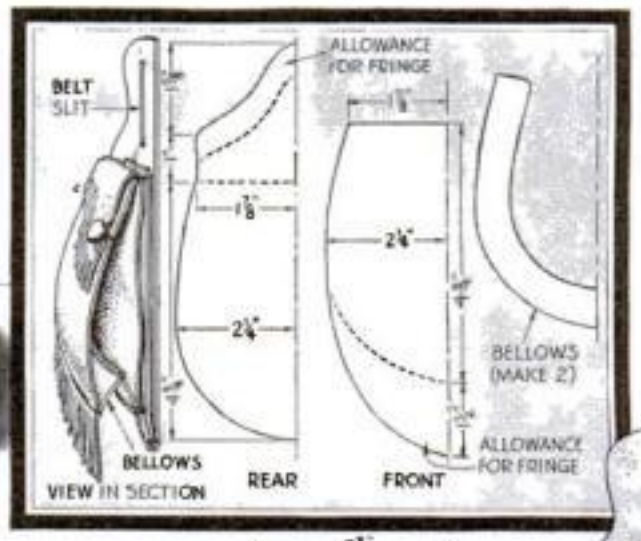
When a hand-power wringer is fastened to the partition between two stationary tubs by means of two clamps in the usual way, the clamps are likely to slip off, and when they do, someone may get hurt. I remedied this fault by inserting two short pieces broken from a mill file between the faces of the clamps and the tub wall. The teeth of the file enable the clamps to hold the wringer securely.—EUGENE AMSTUS.

HOW TO CUT RUBBER EASILY

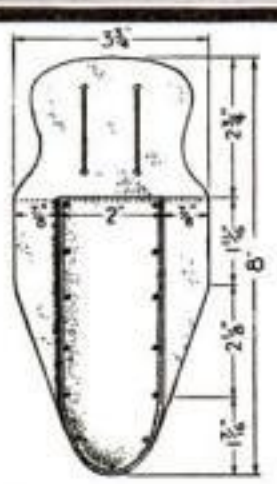
IN CUTTING up old rubber inner tubes or other rubber articles, they should first be moistened with a solution of equal parts water and glycerine for best results. After this treatment a knife or scissors will cut through any reasonable thickness without wavering from a straight line.—K. E. N.

Pouch on Knife Sheath

HOLDS CANOEIST'S KIT



How the sheath is stitched and, above, patterns for pouch



Sheath with pouch added and, at left, the sheath itself

BECAUSE he affects a scanty garb, the canoeman is as shy on pocket space as an Indian. Usually, however, he carries a strong, sharp, short-bladed sheath knife, so if he adds to the belt sheath a leather pouch of moderate size, his worries about the stowage of little things are about over.

To support the pouch properly, the back of the sheath should be made of stiff leather 3¾ in. broad by from 1/16 to ⅛ in. thick. The remains of an old brief case will provide excellent material. A piece of similar material about 2 by 5⅝ in. length is needed for the front. Shape these pieces as indicated, soak them for ten hours, and, laying the front of the sheath in position, pierce for sewing at 1/16-in. intervals. The line of stitching that will later hold the pouch to the sheath goes across the back and top front of the sheath, and these piercings should be made before sewing the sheath itself together.

Wooden jaws are convenient to hold the leather, saddler fashion, while stitching. Use a waxed end, two needles, and an interlocking stitch. Small copper rivets are driven just inside the line of sewing to protect the wearer and the thread from an accidental cut.

While the leather is still soft, punch four ⅛-in. holes where the ends of the belt slots will come and, using a ruler as a guide, cut the slots, which should be 1/16 in. wide.

The pouch can be made from a variety of materials, buckskin heading the list. Two of mine have been made from women's cast-off pocketbooks or hand bags of large size, and a third from suède leather. Any of these can be sewed on a machine with a strong needle provided care is exercised.

TO MAKE the bellows, cut two U-shaped pieces according to the half pattern given. Then stitch the inner edges together, and sew on the back of the pouch as shown. You will have to work slowly to get the front on correctly, for the back has to be held out of the way, and the allowance left for the fringe will get in the way. Now slash the allowances to make the ornamental fringes. Each segment should be approximately 1/16 in. wide.

A bright, roundheaded button, fitted rather tightly in a buttonhole cut in the flap, completes the pouch. The button should be placed well down on the front to assure a tight-fitting flap, and the pouch may be made more secure by the addition of a small sized zipper-type fastening, which is sewn to the threads holding pouch and sheath together on one side and to the lip of the pouch.

To make the sheath safe and prevent loss of the knife, it is well to fit a protecting wooden case within the leather. Mark the blade outline on a piece of white pine ½ by 1¾ by 6 in. Gouge out until the knife lies for half its thickness within the cut. Make a similar piece and fit the two together so that the blade binds when slipped into the recess between them. Now dress the outer faces until the total thickness of the wooden case is little more than 3/16 in. (thickness of blade excluded) and is elliptical in cross section. Smooth with sandpaper, and shellac inside and out. When dry, apply shellac again and slip immediately into the sheath.

IF DESIRED, a still further precaution against the loss of the knife may be taken. Remove the recessed portion of the button snap from an old glove, measure the length necessary to encircle the knife handle just below the knob—measuring from the projecting portion of the snap—and reinsert the recessed half of the button at this point. Now cut out the section of the glove containing the snaps in such a way as to form a strap ¾ in. wide by about 2½ in. long, leaving quite a little extra leather projecting at the recessed end of the snap. Rivet this to the back of the sheath between the belt slits and well toward the top where it will grip the handle of the knife. This will hold it to the side, keep it down in the boot, and prevent it from slipping out even if you stand on your head.

As for contents, my pouch contains the following: A flat tin, formerly an aspirin box, enameled bright red and containing paraffined matches; small compass; sample size tube of ungentine; small roll bandage; length of strong fishline; tweezers for pulling splinters; very small side-cutting pliers; envelope with casein glue; roll of adhesive tape; small razor-sharp penknife; flat tin box containing tacks, copper nails, shingle nails, small screws, screw eyes, cabinetmaker's fastenings, thumb tacks, fishhooks, split shot, staples, piece of beeswax, paraffin, and rosin.—JACK HAZZARD.

HARDWARE FROM HINGES AND BAND IRON

(Continued from page 71)

the hinge is finished and mounted, the unusual form of construction is not noticed.

The strap hinge with both ends of the fishtail design shown in the upper center of the group was also made from a steel T-hinge by cutting off the extreme ends of the straps with the countersunk holes in them, and then hammering out the straps on the anvil to obtain the fishtail or fan-shaped end. The edge was worked from the topside with the hammer to obtain a low chamfered effect made up of hammer marks. The surface of the strap was also lightly hammer-marked. The flat, slightly rounded face of the hammer is used for this, not the ball peen, which gives a pock-marked effect rarely encountered in real wrought work. The notches were filed.

THE strap hinge with the leaf-shaped ends (lower center) was made in the same way except that each side of the strap was cut away with a cold chisel or filed.

The barrels of all the hinges were chiseled over with a small, sharp cold chisel to obtain long facets resembling hammer marks (illustrated in circle). It is not practical to hammer a finished hinge barrel.

The strap or drawer handles shown at the top and bottom of the group were made of band iron slightly less than ⅛ in. in thickness, the ends being cold forged and the handle part formed in the vise. The key plate is a short length of band iron, forged, notched, and drilled. The pull handle shown at the upper left of the group was made in the same way, the curved-over part being hammered on the horn of an anvil or on a round steel bar held in the vise.

All these fixtures are screwed to the woodwork. As most commercial forms of hinges have countersunk holes in them, the newly drilled holes are countersunk also. Flathead screws are ordinarily used, but in this case the screws are altered to suit the pieces by filing the heads slightly round and by filing the facets on them as shown in one of the photographs. This gives the screws a much more attractive finish. Roundheaded screws may be treated in the same way, as may the heads of stove bolts.

These pieces are painted dead black as is usual with wrought iron. First, all dirt and oil are cleaned from them. A very durable finish may then be applied as follows: Paint the cleaned steel with aluminum bronze powder mixed with clear brushing lacquer to the consistency of thin cream. When this is thoroughly dry, brush on a coat of ordinary dead black paint, following this with a second coat when the first is dry. The paint may be purchased ready mixed or made by thinning drop black or ivory black with turpentine.

USING COMMON PINS FOR DECORATIVE PURPOSES

BY PROVIDING them with heads of any desired color and shape, common pins can be used for various decorative purposes and in ship model making and other craftwork. The heads are formed from a mixture of one part white rosin, one part fine white lead in powdered form, and coloring matter. The following pigments are suitable for coloring: chrome yellow; Turkey red; chrome green; ultramarine (for blue); and a mixture of these to obtain other shades and tints. Melt and combine these materials and allow the mixture to cool in the form of sticks, which will be quite hard. Cut off a small piece and touch a heated pin head to it. The material will adhere and may be formed into a ball by twirling over an alcohol lamp.

THE NATIONAL HOMEWORKSHOP GUILD

(Continued from page 69)

William E. Mitchell, president of the Spokane Homecrafters, and a combination desk and cabinet file he has just constructed of solid walnut

been made with the emblem of the National Homeworkshop Guild. At the end of each meeting, this is given to the member at whose home the next meeting is to take place, and on that evening he displays it in front of his house. It is at once a symbol of the Guild and a sign that saves the members looking for house numbers on a dark night.

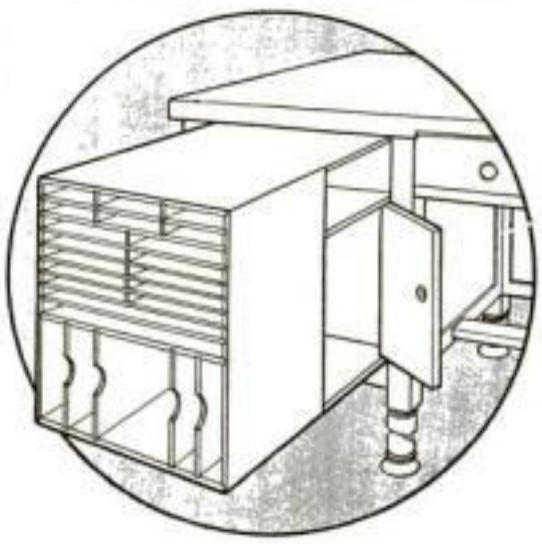
Harold Rickman gave a demonstration on the use of the drill press at a recent meeting of this club, and the lathe was made the subject of another meeting held in the workshop of Dr. H. O. Harris.

The Spokane Homecrafters of Spokane, Wash., under the enthusiastic leadership of William E. Mitchell, have received a number of applications for membership and will soon have a waiting list unless new arrangements for a meeting place are made.

"Our homecraft club was the cause of putting one dent in the depression," Mr. Mitchell writes. "One of our members, following our last meeting, spent $120 cash for home workshop machinery, and he is all 'hopped up' and going strong. One club session lasted for four hours, which will give an idea of the interest shown. The wife of one of the members called up and wanted to know if he was ever coming home again!"

F. Clarke Hughes, who has contributed many articles to POPULAR SCIENCE MONTHLY, gave a talk at one of the recent meetings of the club.

Mr. Mitchell, who is nearly seventy, has been building furniture as a pastime for many years. He has just completed a combination desk and cabinet file shown in two of the accompanying illustrations. The desk is of walnut throughout. The top was made by doweling and gluing together 4 in. wide strips. The typewriter slides out as shown, and there is a filing cabinet for blank paper and letters underneath. This also may be pulled out as a unit to get at shelves in back of it. At the left is another elaborately subdivided cabinet. The desk is wired for lights and telephone. In order to preserve fully the beauty of the figured walnut, the desk was finished with six coats of clear lacquer, except the top, which was given a rubbed finish with linseed oil and turpentine. Mr. Mitchell is now building chairs to go with the desk, as well as a book trough and waste basket, and he expects also to construct a clock. The motive for the chairs is a reproduction of a Cromwellian chair now in the Metropolitan Museum of Art, New York. They will be built of walnut and upholstered in royal blue leather.



The Marshalltown Homeworkshop Club of Marshalltown, Iowa, started with 24 charter members and has a (Continued on page 91)

What Hobbies Are Represented in Your Club?

SEVERAL clubs have taken a poll to discover the favorite hobbies of their members. One man, for example, devotes his spare time to making Indian headdresses. Find out how many hobbies are represented in your club and send the list to the Guild Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y.

HOMEWORKSHOP GUILD

(Continued from page 90)

prospective membership of from 60 to 75. It has appointed a committee to investigate the feasibility of acquiring a club workshop.

An excellent method of assisting club members with their individual problems has been worked out by the Madison Homeworkshop Club of Madison, Wisc. It has started a question box and printed suitable forms for distribution at each meeting to those who have a question or problem to solve. These questions are then distributed to craftsmen who are qualified to answer them. A short but complete report is read at the next meeting.

New Clubs Apply for Charters

HERE *is the official list of new home workshop clubs that have been organized and have applied for charters in the National Homeworkshop Guild:*

Ashtabula Homeworkshop Club, Ashtabula, Ohio
Austin Homeworkshop Club, Austin, Texas.
Beckley Homecraft Club, Beckley, W. Va.
Center Homeworkshop Club, Smith Center, Kans.
The Dalles Homeworkshop Club, The Dalles, Ore.
Denison Homeworkshop Club, Denison, Iowa
Erie Homeworkshop Club, Erie, Pa.
Fox River Homeworkshop Club, Sheridan, Ill.
Kalamazoo Homecraft Club, Kalamazoo, Mich.
Maddock Homeworkshop Club, Maddock, N. Dak.
Marshalltown Homeworkshop Club, Marshalltown, Iowa
Mid-Hudson Homeworkshop Club, Poughkeepsie, N. Y.
New Egypt Home Workshop Club, New Egypt, N. J.
Queen City Homecraft Club, Elmira, N. Y.
Sawdust and Shavings Homeworkshop Club, Yreka, Calif.
Shenango Valley Homeworkshop Club, Sharon, Pa.
Tucson Homeworkshop Club, Tucson, Ariz.
Wood Crafters Club, Richmond, Ind.

These clubs are in addition to those listed in previous issues of POPULAR SCIENCE MONTHLY.

The Topeka Homeworkshop Club of Topeka, Kans., has received so many questions in regard to eligibility for membership that it has announced in the newspapers it will welcome men interested in photography, radio, chemistry, astronomy, microscopy, and similar hobbies. Russell Fairchild, a cabinetmaker, exhibited an unusual collection of rare woods at one meeting of this club.

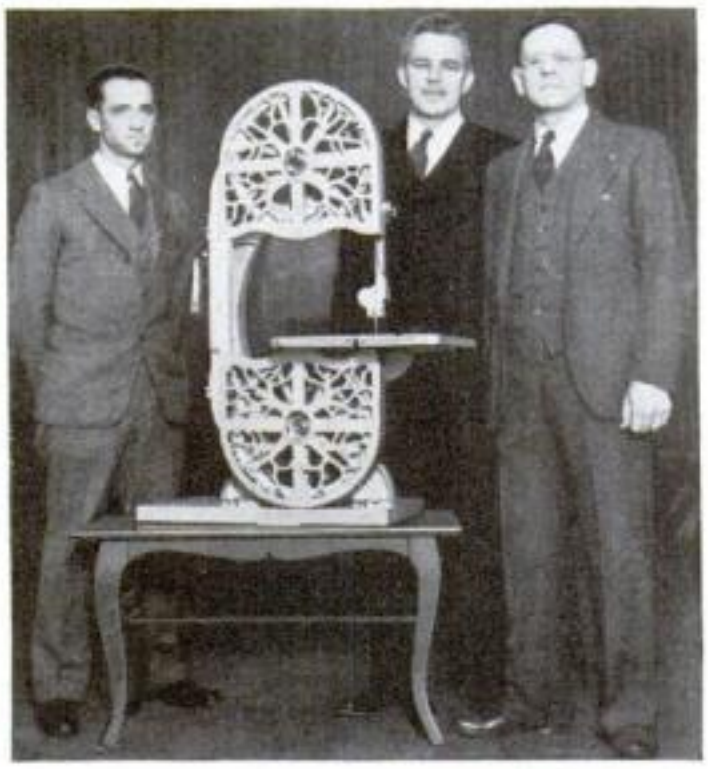
The Amarillo Club has made arrangements to hold woodworking and metal-turning classes in the senior high school under the leadership of various manual training teachers. The use of the shops and machines is given by the board of education, and the teachers' time is covered by a small fee collected from each member. The schools are also coöperating by offering to sell hardwoods to the members at a low price.

One of the recent meetings of this club was held in the United States Helium Plant, where a demonstration in metal turning was given by John Odom, who is connected with that plant. Dr. C. W. Seibel, chief engineer of the plant, is also a member of the club.

At a meeting of the Amateurs' Homeworkshop Club of Richmond, Va., G. H. Smith gave a demonstration in plain and fancy wood turning, and a *(Continued on page 92)*

THE NATIONAL HOMEWORKSHOP GUILD

(Continued from page 91)



A band saw designed and built by Reginald Alcock, James Burns, and Frank Burritt of the Rockford Club

number of samples of rare and imported cabinet woods were placed on exhibition.

A variety of beautifully veneered pieces of woodwork were exhibited by J. W. Buchanan at a recent meeting of the Tucson Homeworkshop Club of Tucson, Ariz. A gavel for L. A. Raymond, president of the club, is to be made by Mr. Buchanan from a piece of ironwood donated by Harold E. Cochrane. W. O. Watkins, secretary of the club, showed a number of airplane models in various stages of construction and several finished models. This club has made a point of encouraging every member to bring some piece of craftwork, whether finished or unfinished, to the meetings.

The Timpanogus Homeworkshop Club of Provo, Utah, held its last meeting in the mechanic art shop of the Provo High School. Maloni Cottam gave an instructive demonstration of the use, sharpening, and care of woodworking tools.

The Cheyenne Hobby Club of Cheyenne, Wyo., held its organization meeting in the junior high school. Edward L. Kopp, Jr., the secretary-treasurer, suggests that every club start a scrapbook for newspaper clippings. He has already done so and believes it will be an exceedingly interesting volume to look over in the years to come.

Three members of the Rockford Homecraft Club—Reginald Alcock, James Burns, and Frank Burritt—have just completed a 14-in. band saw made in its entirety in their home workshops. This is shown in one of the accompanying photographs. They made their own patterns and all the necessary castings, the latter being entirely of aluminum. Mr. Burritt had previously done a good deal of experimenting in casting aluminum in his basement shop. None of the men, however, had special experience in this particular line of work, yet the saw is an excellent machine from the standpoint of design and craftsmanship.

William H. Stewart, who organinzed the club in Kalamazoo, Mich., has long been identified with archery and has been an active worker among Boy Scouts. LeVern T. Ryder, president of the Guild, is an archery enthusiast, and the lists of hobbies sent in by various clubs almost always show that some members have taken up the hobby of making bows and arrows.

A check-up made among the members of the Beckley Homecraft Club of Beckley, W. Va., revealed that the hobbies of the members included woodworking, ornamental metal work, wood turning, archery, and model making. There is a physician, an optometrist, an architect, a lawyer, an officer of a collecting agency, an automobile mechanic, a machinist, a bookkeeper, a newspaper circulation agent, a railroad man, a high school instructor, the chief of police, a criminal court judge, and a student among the members.

Harold Gessert has been elected to fill the vacancy in the office of secretary-treasurer of the Janesville Homeworkshop Club of Janesville, Wisc. Alan W. Dunwiddie is the president of that club.

The interest that has been caused throughout the country by the Guild is reflected in the large number of newspaper clippings that are being received at Guild headquarters and at the offices of POPULAR SCIENCE MONTHLY.

A long leading editorial in the Stamford (Conn.) "Advocate" deserves special mention for its clear, thoughtful, and encouraging analysis of the advantages of the Guild. Thanks are also due to Andrew R. Boone of Los Angeles, Calif., for his excellent presentation of the advantages of the Guild in various Pacific Coast newspapers, and to C. A. Achtenberg, secretary-treasurer of the Madison Homeworkshop Club of Madison, Wisc.

To learn more about the Guild and what it offers to every amateur craftsman, fill out the following coupon.

Keep a Photo Record of Your Club

WHEN your club makes or does something of unusual interest, have some photographs taken and keep them in an album as part of the club records. Send the best of them to the Guild Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y. As many as possible will be published in the magazine. There is almost certain to be at least one expert photographer among the members of your club, and he will know how to take pictures that have the qualities of clearness and human interest.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

Name .....

Address .....

City..... State.....

(Please print very clearly)

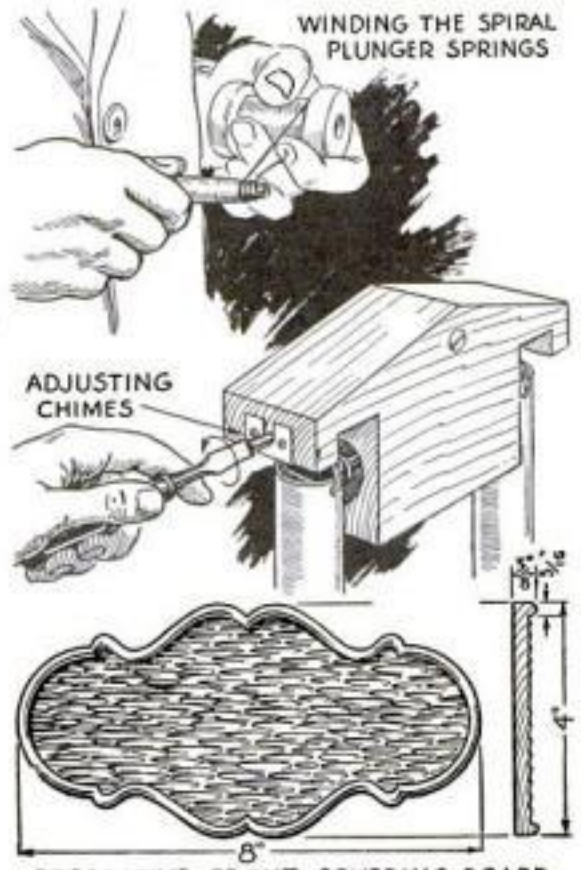
HOW TO MAKE A SET OF MUSICAL CHIMES

(Continued from page 65)

provided for it in the block. Approximately 2 oz. of wire will be required for the coil.

Force the coil into the 1-in. hole in the wood block so that the ends of the coil are the same distance from the outside edge of the hole. To hold the coil firmly in place, pour some shellac around it through the hole in the terminal recess. Secure the coil ends to the terminal screws, which are made from ½-in. No. 8 roundhead wood screws and small brass washers, as shown in Fig. 1.

The details of the plunger are shown in Fig. 7. It is essential that the dimensions be adhered to in making the plunger, also that brass and iron machine screws are used where shown. Although the plunger should not be inserted in the coil until after the coil is in place, an assembled view of the coil, plunger, and springs is given in Fig. 6 to indicate the correct assembly. The spiral



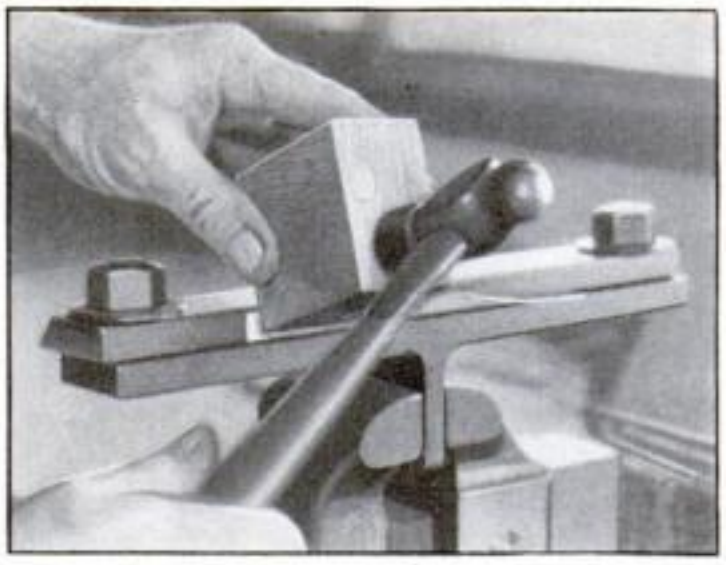
Method of winding the springs and adjusting the tubes, and a suggestion for a cover

springs are wound on a round piece of wood, tapering at the end from ½ to ¼ in., with a slot at the small end to hold the wire. Since the strength of the springs will depend upon the voltage of the transformer, it is advisable to make the springs with five or six turns and then cut away portions of turns until the correct adjustment is obtained. A drawing shows the method of winding the springs.

After the plunger has been inserted in the coil, the brass tubing should be suspended from the adjusting screw. The tubes used by the writer consist of No. 18 seamless brass, 1 in. in diameter and 33 and 36 in. long respectively. While that combination gives a pleasing tone, there are almost limitless combinations that will be equally satisfactory. Gage, diameter, and length may all be varied to suit the individual fancy.

Loop a piece of heavy cord through holes in the tubing, as shown in Fig. 8, and hook it over the end of the adjusting screw which has been pushed through the 5/32-in. hole in the end of the block. Force the screw into the inside hole and secure in place by slipping the retaining plate over the circular slot in the screw. Fasten the plate to the block with small wood screws. If the retaining screw is *(Continued on page 95)*

SMALL JIG BENDS SHEET METAL NEATLY



The parts of the jig and, at left, how it is used to bend sheet metal

WITH this sheet metal bending jig, you can make just as clean, square bends, edges, and seams as any tinsmith can in his big brake, limited only as to size by the smaller capacity of the machine. That new box car for your miniature railroad or that new shield for your radio will have clean-cut, professional looking corners. Another thing: the tinsmith's brake, on account of its size, will not bend a double offset of less than ¼ in., but with this device you can make bends of 1/16 in. or even less, which are often required for small work.

The two main bars constituting the body of the machine are ½ by 2 in. square-edged bar stock, either iron or cold-rolled. The top member is beveled along one of its long edges at a 45-deg. angle for making sharp bends and seaming laps. The lug on the bottom bar, for holding the clamp in a vise, is a piece of the same stock 2 in. long, either welded or bolted with countersunk machine screws to the center of the bottom bar and at right angles to it. The bar should now be bent slightly upward in the middle or given a slight camber, say 1/16 in. or less, so that it will grip the metal to be bent firmly in the center of the clamp.

The bolts are 2 by ⅝ in. U.S.S., either welded or threaded through holes 1 in. from either end of the bar on the center line. The upper or beveled bar has two slots ¼ by 1¼ in., one at either end of the bar, to slip easily over the ⅝ in. bolts in the lower bar. The back edge of these slots—that is, the edge on the side opposite the bevel—should be ¼ in. from the back edge of the bar. The reason for this will be explained presently. Two heavy 1¾-in. washers and two nuts complete the assembly.

In use, the clamp should be firmly gripped in the jaws of a vise, the nuts loosened, the sheet metal inserted between the jaws of the clamp, and the nuts tightened firmly. The bends should be made upward rather than downward, as by this means you can make several bends—the four sides of a box, for instance—without having the metal strike the vise.

Since the slots in the beveled bar are off center, you can slide the beveled bar backward and forward across the lower one so that about 5/16 in. of the lower bar will remain exposed, either on the bevel or the square side, thus forming a little ledge. Unless the edge to be turned is very small, you can start the bend with your hands, bringing the metal into a nearly vertical position; then—and here's where the little ledge comes in—use a small block of wood and a hammer to drive the metal back against the upper bar. Slide the block of wood along the ledge while holding the block parallel with the upper face of the lower bar. This will give a sharp, clean bend.

The capacity of the clamp shown is 9½ in. between the bolts, but there is no reason why this could not be increased several inches. For still greater capacity it would be advisable to increase the size of the bar stock.

A convenient open-end wrench for tightening the nuts can be made from an old T-model spark-plug wrench simply by cutting it in half.—R. GERALD BULLARD.

MAKING PLASTER SET SLOWLY

IN MIXING plaster it is useful to have on hand a saturated solution of tartartic acid. One drop added to each glass of water used for mixing the plaster will delay it from setting for from one to two hours.—E. T. H.

MOLTEN NITRATE COLORS TOOLS BLUE

THAT steel-blue color of the newer razor blades can easily be reproduced on small tools such as wrenches and on angle pieces, rivets, and various small steel fittings. The process consists of exposing the iron or steel article, which must be free from rust, to a definite temperature that favors the formation of this particular blue-colored iron oxide. This is accomplished by immersing the article in molten potassium nitrate or sodium nitrate. The chemical can be melted in a tin can, using the heat from a Bunsen burner. The flame is then lowered, and the article immersed. This will chill the molten chemical and form a crystal covering on the metal, but increasing the heat slightly will cause the coating to melt. Too high a temperature is not desirable. If the chemical is just kept molten, this automatically controls the temperature. The work is allowed to remain for a minute and is then removed and cooled,

The tool is merely left for a minute in a bath of molten potassium or sodium nitrate

HOW TO MAKE A SET OF MUSICAL CHIMES

(Continued from page 93)

now turned, it will be noticed that the cord will ride in the grooves on the screw, causing the tube to move either toward or away from the plunger. The complete unit may be permanently secured by means of a long wood screw after the circuit wires have been connected to the terminal screws.

The coil and plunger are designed to work satisfactorily on 10 volts, alternating current, but it will be necessary to provide a higher voltage if the bell-circuit wires are of small diameter or are unusually long. The standard type of doorbell transformer in common use everywhere is designed to give 10 volts, but for a few cents more—all doorbell transformers are very inexpensive—it is possible to obtain one that has several terminals, giving 6, 12, or 18 volts, as desired.

Plunger and tubes should be so adjusted that when the push button is pressed there will be one clear note sounded, and when the button is released another note will be sounded. If the plunger makes a vibrating sound instead of a single stroke, the tube is too close to the plunger. If the return stroke when the push button is released is sluggish, it will be necessary to increase the tension of the spring on the return stroke side.

If it is desired to cover the face of the unit, a plate may be cut from a piece of mahogany or other hardwood ⅜ or ½ in. thick, as shown, and finished with stain and shellac.

Mr. Ford built his own transformer to operate the door chime. For the benefit of other electrical experimenters who wish to do likewise, he will describe the transformer in a following article.

More Prizes Awarded for Good Photos

THE third in our winter series of indoor photo contests (P. S. M., Jan. '34, p. 68) brought in a surprising variety of excellent pictures. Prizes have been awarded as follows in that contest:

FIRST PRIZE, $25

Charles J. Belden, Pitchfork, Wyo.

SECOND PRIZE, $15

C. A. Briggs, Washington, D. C.

THIRD PRIZE, $5

Haden Hankins, Richmond, Va.

FIVE PRIZES, $1 Each

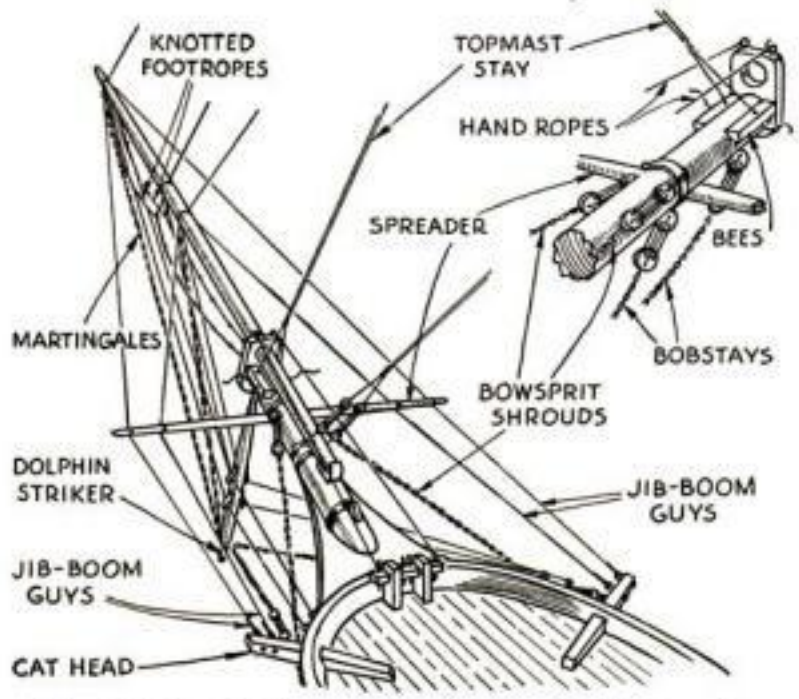
Leo Leonard, Edwardsville, Pa.; Mrs. W. A. Miller, Cadillac, Mich.; H. M. Streeter, Towson, Md.; Mrs. Mildred M. Keeton, Munising, Mich.; Howard Porter, Montezuma School, Los Gatos, Calif.

HONORABLE MENTION—*Teen Becksted, Chicago, Ill.; Boyd V. Evans, Philadelphia, Pa.; Frank Leinhaupel, Chicago, Ill.; Lavilla Perry, Salem, Ore.; Mary Wright Pridham, West Palm Beach, Fla.; H. D. Russell, Rochester, N. Y.; Elmer Reed, La Grange, Ill.; H. H. Schoenlank, Chicago, Ill.; Jack Sherman, Toronto Ont., Canada; J. M. Stofan, Garfield, N. J.; Wm. H. Tourtellotte, Webster, Mass., and H. C. Warner, New Castle, Pa.*

Winners of the February contest will be announced next month.

WE FINISH THE *HARTFORD* MODEL

(Continued from page 83)



When the bowsprit has been rigged as described last month, the jib boom is reeved through the cap, lashed, and guyed

topgallant masts and set up the topgallant rigging. This is seized together at the masthead, comes down through holes in the ends of the crosstrees, and has the ends seized or hitched to a futtock-bar, which can be a needle through the topmast rigging. It is desirable to put ratlines on this rigging too. For the eyes in the topgallant and royal backstays at the mastheads, I used a long seizing, so that the two parts would come down from the sides of the masts.

Some of the stays come to eyebolts in the caps, others to bolts in the mastheads, as shown on the rigging plan. I first set up the stays temporarily, then the backstays, and finally tighten the stays again.

The spencer gaffs should go on next. The goosenecks are set in the eye bands on the masts. The peak halyards start at the end of the gaff, pass through double 3/16-in. blocks bolted to the tops, down through bolts (or blocks) in the deck at the side, and to the pinrail. Two ⅛-in. blocks are seized to the end, and through them lines are rove and belayed to the sides to represent the vangs.

The spanker gaff is similar except that the peak halyard reeves through two single blocks strapped to eyes on the masthead. The vangs belay to cleats on the deck.

The ends of the fore and main yards require 3/16-in. blocks above and abaft. The topping lifts start at the single yardarm blocks, reeve through a double block, round again, and down through the sheet bitts. With tackles like this, I reeve them off first, then seize the awkwardly placed block in position, in this case to the arm on the cap. When these are rove, I put the pin in the truss and stretch the sling chain to the bolt in the middle.

The crossjack yard is similarly rigged except that the brace blocks are on the foreside. This applies to all the mizzen yards. The braces I leave until last.

For the topsail yards one needs brace blocks and standing lifts, which are single lines from yardarm to yardarm with sufficient slack to allow the yards to lie ¼ in. or so above the caps. To the center bolt, a light chain is fastened, which reeves through the hole in the mast. To the afterend of the chain is fastened a ¼-in. block, through which is rove a heavy cord, one end of which is bolted to the deck while the other ends in a double block that is connected with a tackle to a triple block at the deck. This end finishes at the triple block and leads up to the pinrail.

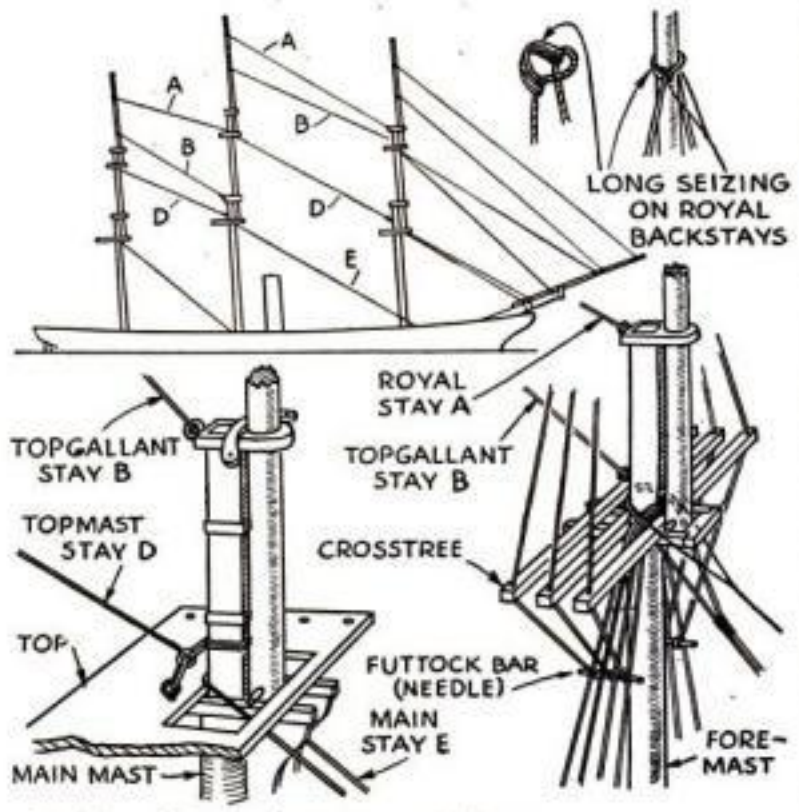
Topgallant and royal yards are rigged much the same. Cord can be used instead of chain for the ties. It comes down to two double blocks for the topgallant, and to a double and a single block for the royal halyards.

The fore-topsail halyard tackle is to port, and the halyards then alternate as they go up. The main halyards are on opposite sides, and the mizzen reverse again.

The lead of the braces can be seen on the rigging plan. I start reeving them from the top. All hauling parts lead down abaft the masts and are as straight as possible. Royal, single, come to the ship's side; topgallant, double, are the same. Topsail braces belay amidships. Forebraces run to the sides from blocks bolted to the cheeks; main braces from blocks on the stern galleries to the pinrail; and crossjack braces lead to the sides through blocks seized to the rigging.

Before reeving the braces, we should rig out the jib boom. It reeves through the cap and is lashed to the bowsprit just outside the cleat. The guys come from the first and second stops. I split the rope to form cut splices to go on the boom, then hitched them to the spreader and turned them back through the bolts in the catheads.

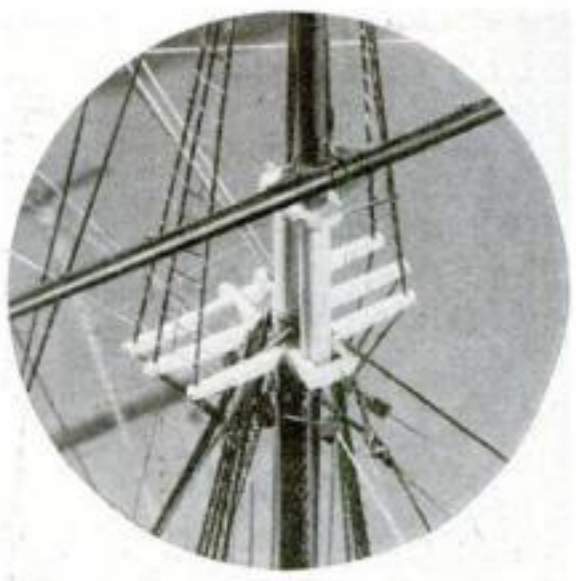
The dolphin striker must now be set up. A light chain comes from each stop of the jib boom, the bight being seized to the eye at the end of the dolphin striker. From the other eyes come similar chains, which are set up with lanyards to the inner eyes of the catheads. Get them very tight to bring the jib boom down a bit. A good strain on the head stays should slightly tighten all the others. The jib boom has footropes at *(Continued on page 97)*



Position of the various stays, which are set up as soon as the topmast shrouds are on, and methods of fastening them

THE *HARTFORD* MODEL

(Continued from page 96)



The topgallant shrouds come down through holes in the crosstrees to a futtock bar

either side, slung from the end to the legs of the fore-topmast stay, with stirrups at the inner stop, and one knot or bead outside this and two inside. There is also a hand rope from bolts in the cap to others in the cap rail. These are sometimes cross-laced for the staysail to lie in.

It would presumably be correct to have a netting under the jib boom from the end to the spreader. This can be made of tarlatan or mosquito netting stiffened with black shellac.

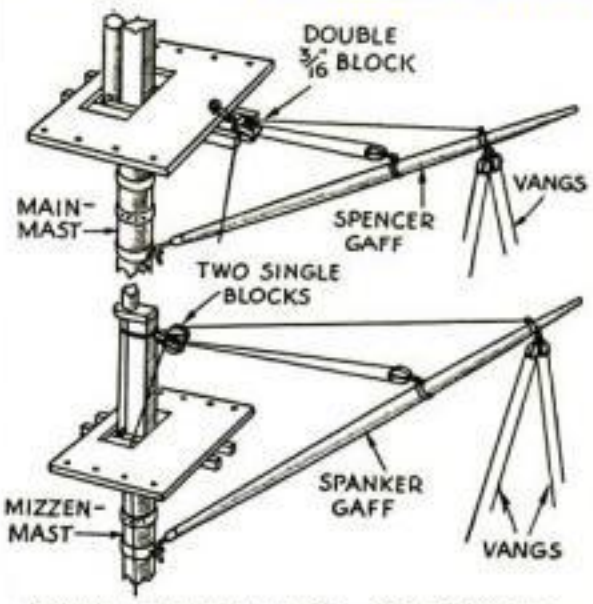
At the mastheads there should be small round trucks, gilded.

The anchors are of the usual type 1½ in. long, with wooden stocks. The bowers are hung from the catheads by the stoppers with one palm resting on the billboard and there lashed with a short chain to staples. Their chains lead in through the forward hawse pipes along the deck and down the forward chain pipes.

The sheet anchors, as shown in the photographs, are not exactly in the right place. The palms should be shifted a little forward to rest on the rail, and the stocks should lie horizontal and be lashed in position so as to clear the gun ports. The chains lead to after pipes.

There are five boats. Two 33-ft. launches or longboats hang in iron davits amidships. The davits swing in sockets and bands outside the hull. The boats are hung with twofold tackles and belay to cleats on the davits. A spar should be lashed across the davits against which to bring the gunwale, as the boats are lashed to the davits with the gripes (the lines passed around the boat to prevent swinging). A span carried across the davit heads and brought to the rail will complete the assembly.

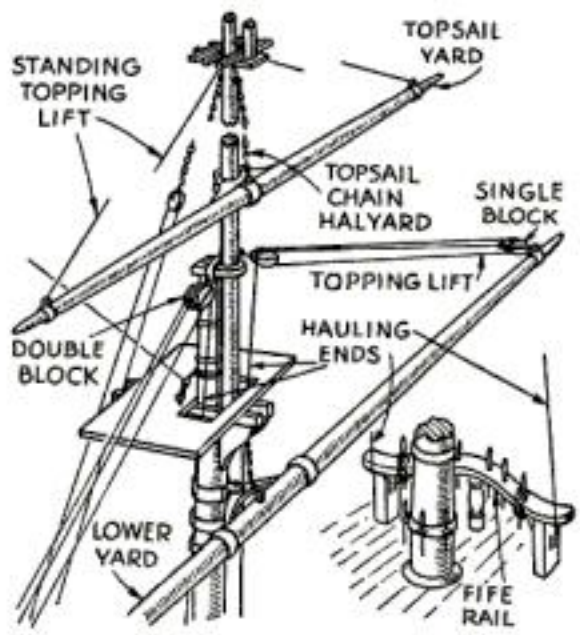
Two 29-ft. whaleboats are hung from wooden spar davits in the mizzen rigging. These spars set in shoes *(Continued on page 98)*



Spencer and spanker gaffs. Note difference in arrangement of their peak halyard blocks

WE FINISH THE *HARTFORD* MODEL

(Continued from page 97)



How yards are rigged. The topping lifts of the lower yards are carried down to the deck

on the channels and are suspended by a span from high up on the rigging.

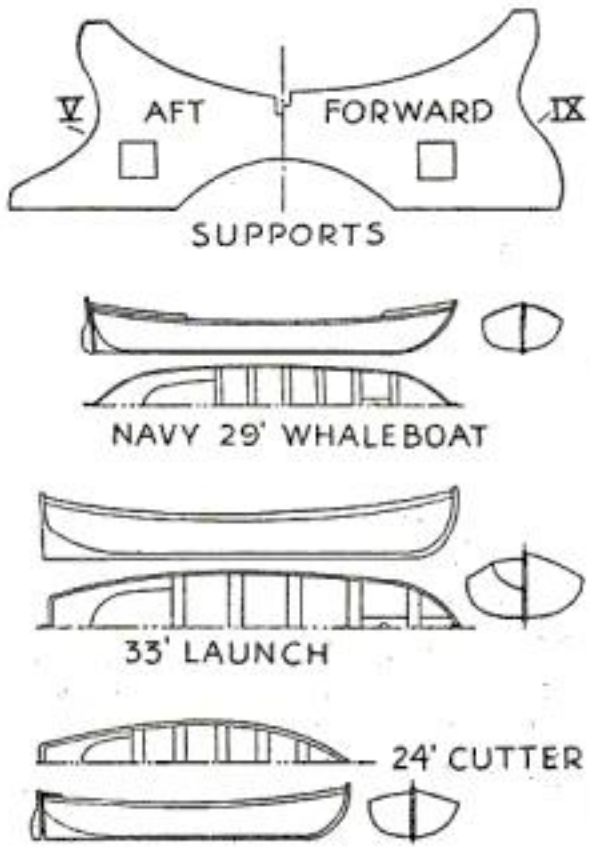
A 24-ft. cutter hangs over the stern from iron davits. These are shorter than the others and swing in sockets on the quarters. The boats are all black outside, with gray bottom boards and with the thwarts and everything above white.

In a future issue we intend to describe in detail the making of ship's boats for any type of scale model in which extreme accuracy is desired.

The base for the *Hartford* can be two uprights made to fit at sections 5 and 11, as shown in one of the drawings. One or two crossbars are used to connect them.

The correct ensign for 1863 has thirteen stripes and thirty-five stars. The United States Navy Department has informed me that David G. Farragut as senior rear admiral (he was made full admiral in 1866) hoisted a plain blue flag at the main of the *Hartford,* his flagship, at New Orleans on August 13, 1862, it being the flag he had previously flown at the mizzen.

From the United States Navy signal book of 1859 was taken the signal for commencing battle, which was to be hoisted where best seen. This we ran up at the mizzen. As far as we are concerned, no doubt a signal for ceasing battle might be more suitable, because the model is now finished. I am sure that if you have worked carefully, everyone will salute its blue flag and say, "Well done."



The boats of the *Hartford* and a diagram of a stand. Only half of each cradle is shown

TRAILER RACK FOR CARRYING BOAT

(Continued from page 67)

List of Materials for Boat Rack

- 4 pc. ¾-in. I. D. (inside diameter) iron pipe, 5 ft. long, for uprights and crosspieces.
- 2 pc. ¾-in. I. D. iron pipe, 6 ft. long, for rear uprights.
- 2 pc. ¾-in. I. D. iron pipe, 9 ft. long, for lengthwise members.
- 2 pc. ⅜-in. I. D. iron pipe for 18-in. brackets.
- 4 three-way pipe ells, ¾ in.
- 2 flanges, ¾ in.
- 2 pc. 2 by 4 in. by 6 ft., oak or yellow pine, for crosspieces.
- 2 pc. 1½ by 1½ in. by 6 ft., oak or yellow pine, for clamping pieces.
- 2 pc. 5/16-in. iron rod, 24 in. long, and 4 nuts.
- 4 machine bolts 1¼ by ¾ in. for brackets.
- 2 machine bolts 1½ by ⅜ in. for bumper fittings.
- 4 machine bolts 3 by ¾ in. for wood frames.
- 8 stove bolts 1½ by ¼ in. for fastening flanges.

shown in the drawing. The boat, resting upon these shaped pieces, will shift about less.

A clamping device to hold the boat securely to the rack is made of 1½-in. square oak or yellow pine of the same length as the crosspieces. Place the boat on the rack, lay the clamping piece over the top of the hull, and cut to the right length two pieces of 5/16- or ⅜-in. iron rod. Allow 1½ in. of the rod to project above and below the pieces. Thread the ends of the rods for 2 in., and drill for the rod at points 2 in. from the ends of the clamp piece and lower crosspiece.

Brackets for the rack are made as shown of ⅜-in. inside diameter pipe flattened on the ends. The flattened ends are drilled and secured to the pipe frame with 1¼ by ¼ in. machine bolts. For extra rigidity, brackets in the rear may be found necessary.

Rowboats and runabouts with wooden decks may be secured forward with a clamping piece such as has been described, but it will be necessary to tie the forward ends of boats that have light decks.

Old inner tubes, sacks, or blankets may be used to pad the front and rear crosspieces.

Canoes and round-bottom boats are best carried upside down. If the hull is transported right side up so as to carry luggage within, a padded cradle is constructed. A canvas cover may be made to protect anything carried in the hull in bad weather.

REMOVING GUMMED OIL

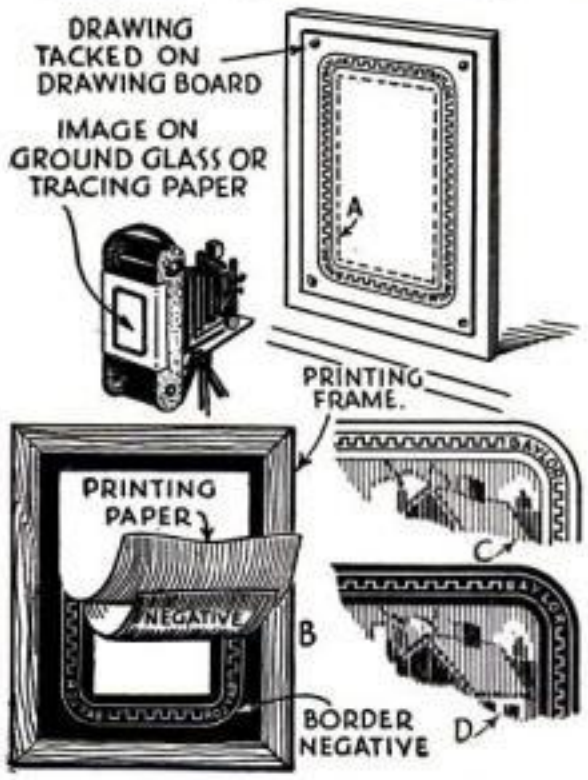
WHEN it is found that the oil used to lubricate mechanical parts has become gummy, remove it with a strong lye solution applied with an old toothbrush. Rinse off the parts with water, then apply alcohol to remove water. Oils that gum up do not lubricate well; use only the best highly-refined oils.—E. T. H.

HOW TO MAKE ORIGINAL BORDERS FOR PHOTOS

WITH a good camera, a little artistic ability, and developing facilities, an amateur photographer can make his own border prints.

First, decide upon the design. The initials of the photographer may be placed in the corner, and other features added. This border is then drawn on drawing paper with black ink. Care should be taken in getting the right proportion of width and breadth in the drawing, and it should be made as large as convenient.

This drawing is mounted on a drawing board or other flat surface with thumb tacks and a negative made. The drawing may be illuminated with flood lights, a flash bulb, or sunlight. Care should be taken in getting the right focus. The image of the border should be the exact size of the desired border on the prints. If the camera is not provided



The large drawing, the method of doing the printing, and two examples of final result

with a ground glass screen, the back of the camera can be removed and a piece of ground glass or paper inserted for focusing.

When the film or plate is developed, it will be noticed that the negative is dark except for the clear lines of the border pattern. The inside of the border is cut out with a sharp knife or razor blade along the dotted lines marked *A*. This negative is then placed in the printing frame.

The negative to be printed should be no larger than the border itself and should be placed in the frame so as to be just inside the border. A piece of printing paper is placed over the negative and border negative as shown at *B*. The print is then exposed to the light and developed in the usual manner. The finished print will have a border around it as shown at *C*.

Another type of border is shown at *D*. An unexposed film or plate is placed face downward over the border negative instead of a piece of printing paper. This is exposed to the light for only an instant, then developed. This negative will be clear except for the dark border lines. The negative is used in the same manner as the one first described.—W. TRUETT ROUSE.

● ● ●

Shallow holes and dents in either wood or metal can be filled more easily with a plastic wood composition if the spots are first coated with lacquer and allowed to become tacky.—R. D. Y.

RUBBER RIM PROTECTS ROUND OILSTONE

SMALL, round, bench oilstones, although very useful for many sharpening purposes, would be more popular if they were not so easily dropped and broken. It is a simple matter to prevent this. Merely snap a soft rubber fruit-jar-cover remover around the stone as shown above. This does not interfere with most jobs of point or edge dressing, and even if the stone is dropped on a concrete floor it is not likely to break. The rubber also makes it easier for the fingers to grip the stone.—FRANK W. BENTLEY, JR.

RIVET PRESS FOR RELINING BRAKES

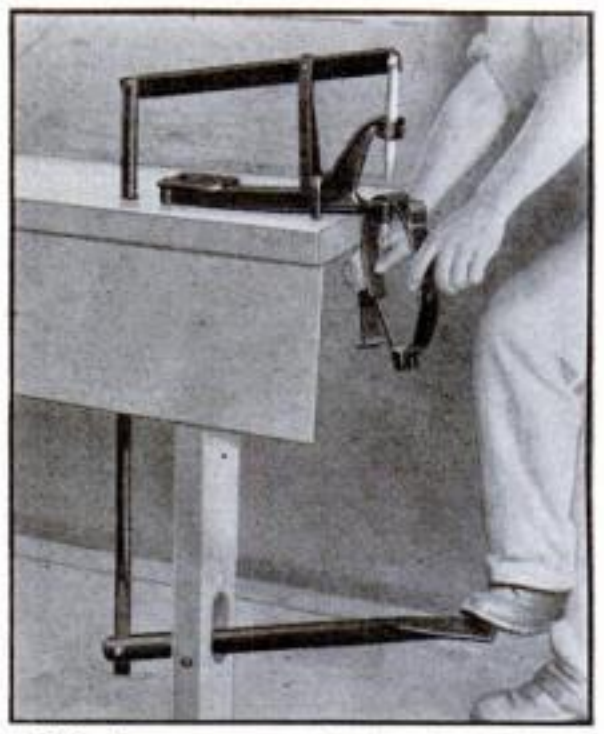
WITH this practical, homemade rivet press it is a simple matter to punch out the old rivets and install a new set of brake linings. The press is surprisingly powerful.

The photograph so clearly shows the arrangement of the various parts that little need be added. Any practical man can build such a press in a few hours of spare time at practically no expense.

The foot lever is a piece of 2-in. pipe flattened at one end and slotted at the other to receive the upright plunger, which passes through a suitable hole in the bench top. The upright is likewise a piece of pipe, ¾ in. in size, treated in a similar manner. The top lever is a straight piece of bar stock 1½ by ⅜ in. with three holes drilled through it.

The plunger is one of the original steering spindle bolts turned upside down and slotted at the upper end to receive the forward end of the upper lever. Since this pin is hardened, the slot will have to be ground in with a thin wheel or the end of the pin will have to be annealed and the slot sawed with a hack saw and drilled for the pin.

Simple dies for punching out old rivets and expanding the ends of the new ones may be filed or ground from suitable bolts of a size to fit the threads in the lower



Made from scrap parts in a few hours' time, this press does the work of an expensive one

end of the spindle (the hole formerly occupied by the oil cup or grease-gun coupling) and casehardened; or such dies may be purchased readymade at small expense from auto supply houses.

The upright brace or fulcrum for supporting the top lever is a piece of ordinary bar stock ¾ by 3/16 in. bolted to the axle through a suitable hole bored through that member.

A U-bolt through the top of the bench at the base of the fork in the axle, together with a couple of bolts through the spring perch where the axle was sawed off, will serve to hold the device solidly to the bench.

An ordinary valve spring (not shown in the photograph) threaded on the spindle bolt between the top lever and the top of the axle fork serves to cushion the thrust when old rivets are being punched out.—R. G. B.

CEMENTING SANDPAPER TO METAL DISK

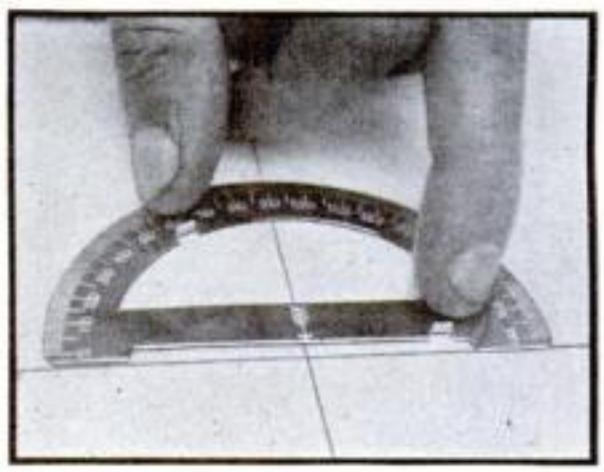
VARIOUS adhesives are used by amateur craftsmen to attach sanding disks to the metal plates that are now so commonly used for disk-sanding operations. Among them are shellac, collodion, glue, and plastic metal cements of different types. I tried them all without entirely satisfactory results, and then discovered that a mixture of rosin and castor oil would do the trick. The rosin is melted in a tin can, and about one third of its volume of castor oil is stirred into it. The metal disk is warmed over a flame for half a minute or so if it is cold, and the mixture is smeared over it. The disk of garnet paper or other abrasive is applied immediately, and the whole is set face down on the floor and weighted. The disk is ready for use as soon as it has cooled. It will stand up under exceptional use.—R. W.

For attaching garnet paper or other abrasives to a metal sanding disk, a hot mixture of rosin and castor oil makes a good adhesive

TIN-CAN DIPPERS AID IN PAINTING

FOR handling gummy or sticky liquids such as paints and oils, a serviceable dipper can be made from a No. 2 or 2½ tin can in a moment's time with a pair of tin snips. Such a dipper is more convenient to use than an empty can just as it comes from the kitchen, and it saves soiling the fingers and avoids wasting material. Besides, it can be thrown away after use, since it is easier to make a new dipper than clean an old one. Cut the top of the can off at an angle and fasten it with two nails to a broomstick handle about 12 in. long as shown in the accompanying photograph.—E. D. HAY.

This type of dipper is so easily made that it is thrown away after use to save cleaning



FINGER GRIPS FOR THIN METAL PROTRACTORS

THE small, light, and inexpensive metal protractors used so commonly in school work in connection with geometry and for amateur drafting are difficult to handle and move over the paper. The fingers cannot easily grip them, and as a result they are often rubbed over the work in such a way as to smudge the lines. To remedy this, make cuts in two places on the protractor as shown and bend up the edge between to right angles. These slight projections give a good grip for the fingers.—B. W. F.

HANDYMAN'S One Dollar MODERN Manuals

for USEFUL PASTIME and for PROFIT!

Put in your spare time this fascinating way. Enjoy the thrills of making things, fixing things, experimenting, exploring magic worlds of wonder, with these *new* inexpensive guide books. All made for non-technical readers. Think of it—only $1.00 each for these NEW cloth-bound Manuals. This low price is temporary; we may have to raise it later. Not just books of WORDS, but diagrams, drawings, directions, showing each stage of the job. Full-sized books, about 200 pages each. Sold separately—take your choice. Use the coupon below.

Now READY for IMMEDIATE DELIVERY

1. MANUAL OF SHIP MODEL MAKING. How to make any model. Here are clearly diagramed the many short cuts, kinks, and time-saving methods of experts. Complete plans and specifications for a gorgeous galleon, clipper ship, etc. Almost 100 illustrations. Full cloth bound $1.00.

2. THE HOME CHEMIST. How to set up and operate an inexpensive home laboratory with odds and ends of material available in every home. Many thrilling, practical, useful experiments and tests, entertaining, instructive, valuable, pointing the way to research and new discoveries. Many diagrams and illustrations. Full cloth bound $1.00.

3. WONDERS THROUGH THE MICROSCOPE. Turn an inexpensive microscope on hundreds of specimens within a stone's throw of your front door and you step off into a new world of wonders. Complete Manual for amateurs. How to use equipment, secure and preserve specimens, take photomicrographs, etc. Numerous illustrations. Full cloth bound $1.00.

4. BOOK OF FORMULAS. For household, shop, laboratory. Formulas, recipes, methods and secret processes. Make your own beverages, glues, cements, cleaners, polishes, enamels, paints, cosmetics, dyes, inks, toothpastes, soaps, silver and nickel plate, metal alloys, photo chemicals, oils, lubricants—and scores of articles for home use or for founding your own business through making and selling. Full cloth bound $1.00.

5. FIX IT YOURSELF. A new edition of a famous book, showing with diagrams and directions, how to fix and repair furniture, electric outlets, windows, doors, leaky pipes, floor boards, chimneys, boilers, weather proofing, painting and hundreds of other construction and repair jobs. Full cloth bound $1.00.

6. WOODWORKER'S TURNING AND JOINING MANUAL. The simplest, most practical ways to make end tables, chairs, benches, highboys, book-racks, cabinets, all kinds of furniture in your spare time. A revelation of simplicity and helpfulness. Many illustrations. Full cloth bound $1.00.

SEND NO MONEY!

When the books arrive pay the postman $1.00 per book plus a few cents postage. Money refunded on books returned within 5 days of receipt.

MONEY-BACK ORDER FORM

POPULAR SCIENCE MONTHLY, [5-34]
381 Fourth Ave., New York, N. Y.

Send me the Handyman's Modern Manuals as indicated by the numbers checked below.

1—Ship Model **2—Home Chemist** **3—Microscope** **4—Formulas** **5—Fix It** **6—Woodworkers**

When the books arrive I will pay the postman $1.00 for each book delivered plus a few cents postage. You are to refund what I have paid if I return the books within five days of their receipt.

NAME .....

ADDRESS .....

CITY .....

(Orders outside United States must be accompanied by cash)

STEEL BRIDGE FOR MODEL RAILWAY

ALTHOUGH it may seem rather complicated, this steel bridge is not difficult for a model maker to build for his model railway, and it is more modern than the pile trestle described last month (P.S.M., Apr. '34, p. 98). It may, of course, be simplified to any extent, but for the time being we shall assume that metal is to be used.

Brass, being easy to handle, will probably be the most suitable. It can be purchased in strips of any desired width and is easily soldered or drilled. If you are building to a scale of ¼ in. to the foot, all of the dimensions given on the plans may be reduced to actual size by dividing by three, the result being the size of the member in sixteenths of an inch. Take, for example, the end post *A* in Figs. 3 and 4, which is shown as 25 in. wide with two 20-in. webs. Dividing the dimensions by three and using the nearest sixteenth, the 25-in. plate works out to be 8/16 or ½ in. wide, and the two webs 7/16 in. wide. The vertical member *E* would be built up of ⅝-in. strips for the sides and a ¼-in. strip for the center web. The bottom chords *C* would be of ⅜-in. strips tied with plates ¼ in. wide.

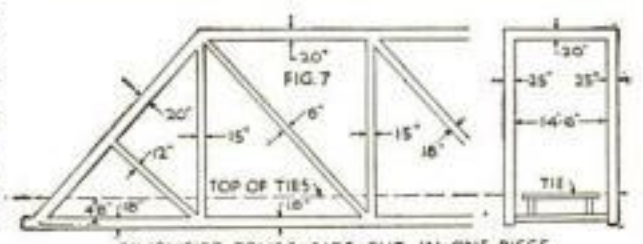
The original plans for this bridge showed the bridge ties supported by 48-in. fabricated I-beams. As shown in Fig. 4, timber stringers have been substituted for these I-beams. They are inconspicious, and the ties can be fastened directly to the stringers with brads.

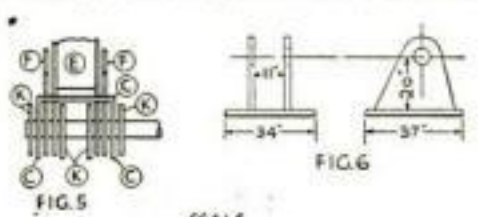
Figure 5 is a typical sectional view taken at the intersection of members *C*, *E*, *F*, and *K*, showing their arrangement on the connecting pin. Note that there are four eyebars *K* between each of the two center spans.

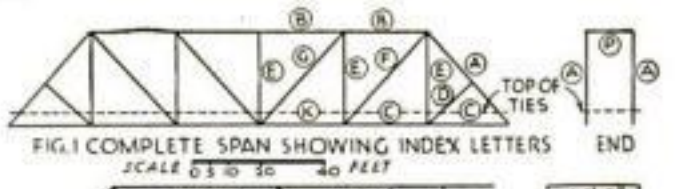
The bearing shoes, of which there are four, are made up of heavier material and are shown in detail in Fig. 6.

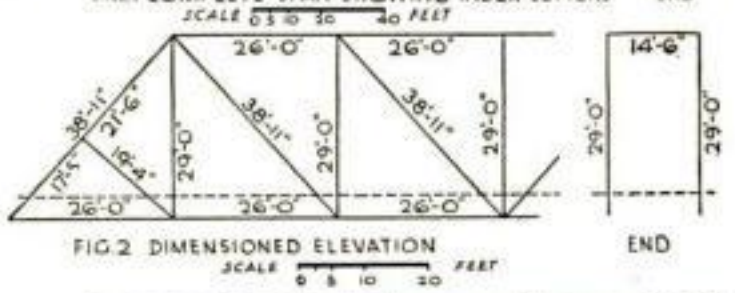
For those who desire simpler construction, Fig. 7 shows the truss as it would appear if cut from one solid piece of plywood or some similar material. In this case the eyebars have been omitted and square structural members substituted.

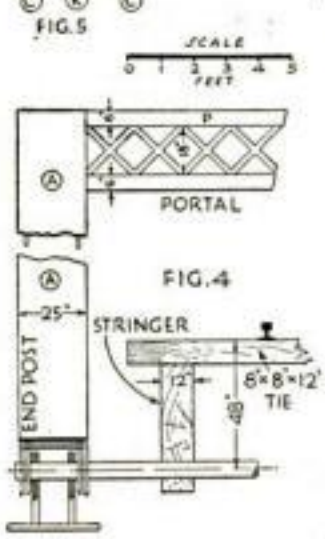
Figure 1 is a key giving the index letters that have been used in the other drawings, and Fig. 2 shows full-size dimensions taken from center to center of the various structural parts of the bridge.—J. W. CLEMENT.

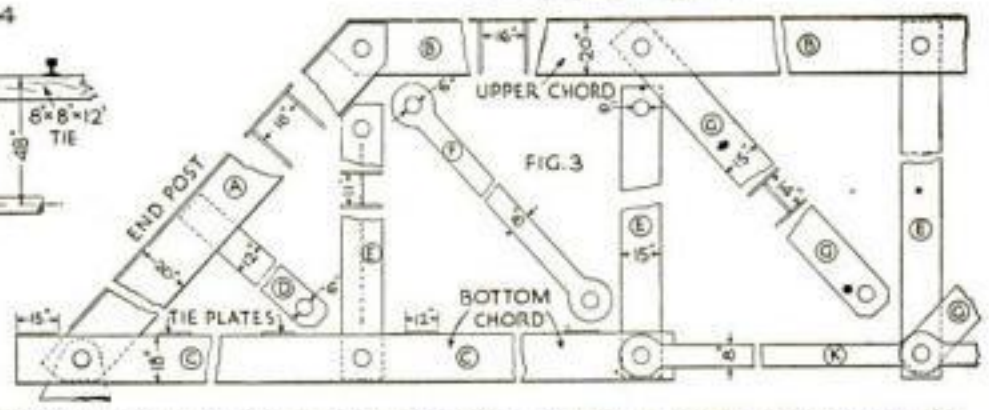








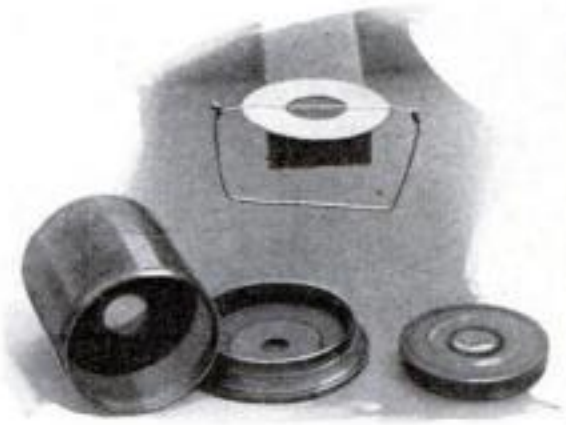




Details of a single-span steel truss with actual dimensions so that a model maker can build an accurate model to any scale. The upper drawing (Fig. 7) shows a simplified construction

MOUNTING CROSS HAIRS MADE OF SPIDER WEB

CROSS hairs of some description are an essential part of such optical instruments as transits and finder telescopes when it is necessary to locate some object accurately within the field of view. The finest of



How a bow-shaped piece of wire is used to set cross hairs over a telescope diaphragm

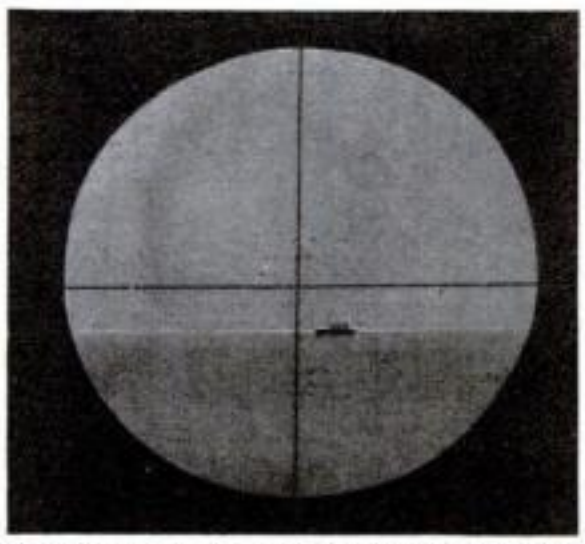
all cross hairs are those made from spider web, and when the correct methods are used, they are easy to install.

A cell or diaphragm of thin metal or cardboard is required to carry the cross hairs. It should be just large enough to fit snugly within the tube of the instrument, and the center hole should be but slightly larger than that of the regular diaphragm. After accurately marking off one surface into quarters, lay the diaphragm near the end of some projecting support, as shown.

A small U-shaped bow is made from a piece of fine, stiff wire such as a wire violin string, and a tiny bit of wax or chewing gum is affixed to either end. A suitable strand of uniform thickness from the radial lines or brace lines of a spider web is now located and secured to the bow with a couple of turns about each waxed end.

The web should now be laid directly across the center of the diaphragm. The weight of the suspended bow serves to stretch the web tightly. Secure the web at each end with a drop of shellac or glue; and when this has hardened, clip off the ends of the web, give the diaphragm a quarter turn, and repeat the process with the second strand.

The entire cell should be carefully pushed into the tube or eyepiece of the instrument to the position which gives the cross hairs the most perfect focus. Applying a few drops of glue will serve to keep it permanently in position.—L. C. PELTIER.



Two strands of spider web set in a telescope finder. They are the best of all cross hairs

When ordering back issues of POPULAR SCIENCE MONTHLY, *please send 25 cents for each issue except the current one and the three issues immediately preceding. These four issues are only 15 cents each.*

STRANGE PLANTS YOU CAN SEE IN YOUR MICROSCOPE GARDEN

(Continued from page 43)

gentle flame if necessary. If your bacteria have been distributed on the cover glass, pass it two or three times through the gas flame, bacteria side up. This "fixes" the tiny plants. If they are on a slide, you can pass it through the flame a half-dozen times. A still better way is to place a few drops of ninety-five percent alcohol on the specimen, let the excess drain off or remove it with a blotter, and then touch a match to the remaining alcohol film while the slide is held with the bacteria-covered side uppermost. Let it burn itself away.

To stain the bacteria, place a few drops of water on the fixed specimens, and add a drop of Loeffler's methylene blue or other stain. Let it act several minutes, then wash off with clear water and dry. Fasten the cover glass to the slide with balsam.

YOU can spend a thrilling evening looking at the molds that spring up like weeds in your dust garden. You can observe them in their natural states, or color them with various stains. Molds have been discussed in previous articles of this series. (P.S.M. Oct., '33 p. 42).

When handling bacteria and molds with the dissecting needle, you can make sure that particles from one specimen do not become mixed with those of another by heating the needle to redness in a flame, after each transfer. This action sterilizes the needle perfectly.

There are other types of micro gardens that you can establish. The growing of yeast plants is simple, and the plants themselves form one of nature's most interesting wonders. Your yeast garden will consist of a small tumbler half full of a liquid medium made by diluting molasses with about six times its volume of water. Into this soil crush a single tablet of brewer's yeast or a piece of yeast cake the size of an aspirin tablet. Growth starts almost at once, and you can obtain specimens within a few hours. Simply remove a drop from the cloudy part of the liquid and place it on a slide, dropping a cover glass over it. At 300 or so diameters you can see the tiny plants. You can stain them with dilute tincture of iodine.

A single cell of brewer's yeast is round or oval in shape, with the nucleus plainly visible. It reproduces by budding, the buds projecting out from the parent cell like a grotesque nose. Often the tiny plants will cling together to form a chain or branched group. Some yeast plants take the forms of a club having a knob at one end. If you watch closely, or make repeated observations over a short period, you can see one of the most interesting things in the microscopic world—a single cell growing and dividing into two. Notice particularly how the nucleus behaves.

A YEAST plant, in growing, converts the sugar that is its food into alcohol and carbon dioxide. That action is the basis of a great industry, the manufacture of alcoholic beverages. You can trap the carbon dioxide by inverting, in the molasses and yeast mixture, a test tube that has been filled with some of the same mixture. Arrange the tube so that it will remain upside down for several days. At the end of that time, you will have collected a little pocket of gas at the top of the liquid column. A match plunged into this gas goes out at once because the "C-O-$_2$" will not support combustion.

If you search carefully through the remains of a rotted log in the woods, and perhaps dig into the ground a bit, you may find more tiny wonders of the plant world. Some are little fungus plants with minute knobs and cups, each plant hardly larger than the end of a common pin. Then you may discover some other wee plants, real plants with tiny leaves and stalks that will provide you with abundant material for observation. Take home some of the rotted wood and surrounding soil, together with the plant samples, and establish a garden in a clean petri dish or any other suitable covered container. Keep the soil moist and warm, and your miniature plants will thrive for a long time.

Micro gardens play a highly important part in the lives of millions of persons. Physicians, hospitals, and research workers use methods similar to those just outlined for growing bacteria for study, for identifying disease, or for watching the effectiveness of treatment of an infection or contagious disease.

How big is a yeast plant?

PERHAPS a question like that has occurred to you more than once as you gazed at some microscopic treasure. You can answer it with fair accuracy by a simple measuring method.

Arrange your microscope so that you can see an image of the specimen as if it were projected on a white sheet of paper. You can do this by gazing into the eyepiece with one eye and at a sheet of blank paper with the other. If you find it difficult to arrange the paper so that the microscope stage does not interfere, tilt the instrument so that the tube is horizontal, and use a mirror set at a forty-five degree angle, (P.S.M., Apr. '33, p. 49); or another attachment that will be described presently.

In order to make a reliable measurement, the distance from your eye to the paper should be the same as the distance from your eye to the microscope stage or a point slightly below. For a standard microscope of the better class, this distance is approximately ten inches. It actually is the distance from the eye to the image of the specimen formed by the system of lenses. When the image is projected clearly on the paper, mark with a pencil the points between which you wish to measure, or use dividers. You may have a little difficulty balancing the illumination on the paper and on the object.

Now measure the distance between the pencil points, and divide it by the number of times the object was magnified. It is assumed, of course, that you know the power of your microscope. For example, if a diatom image proved to be three-quarter inch long when projected against the paper, and the microscope was magnifying 450 diameters, the actual length would be three-fourths divided by 450, or 1/600 inch.

A SIMPLE little device that is useful in making drawings or measurements consists of a very thin, square cover glass mounted at an angle of forty-five degrees to the eyepiece. The microscope is placed in a horizontal position, and the eye is held so that it is very near the center of the glass, on the side nearer the lens. Rays from the eyepiece are reflected into the eye, so that they seem to come from the paper that can be seen through the cover glass.

Still another way of measuring the size of an image or, if the size of the original specimen is known, the magnifying power of the instrument, is to project the image on a ground glass set at the proper distance from the eye piece. Also, the image can be projected on a white card if little or no extraneous light reaches the card. An arc lamp or high-intensity Mazda lamp is useful for illuminating the specimen, when such projection systems are used.

Cleaning glass slides, cover glasses, and other glassware used in the microscope laboratory sometimes presents a problem. Several cleaning solutions *(Continued on page 105)*

PLANTS YOU CAN SEE IN MICROSCOPE GARDEN

(Continued from page 104)

have been recommended. A widely used laboratory preparation is made by mixing one ounce of commercial sulphuric acid and one ounce of potassium bichromate with ten ounces of water. This preparation will remove grease and balsam from slides. It has one bad point: it is hard on fingers, clothing, and other things.

If you have started a collection of color filters for visual observation and photomicrography, you will be wise to standardize them as to size, say two by two inches and then build a box in which to keep them. A filter box made from walnut is illustrated. It consists of a main portion whose longest sides are grooved to receive the glass squares, much like a standard microscope slide file. The lid fits into a rabbeted groove at the top of the box, the rabbet making a fairly dustproof joint. The corner joints of the box and lid can be made in any standard manner. The best appearance is produced by miter joints that go together like the corners of a picture frame. Small brass hinges and a ten-cent catch complete the filter box. With the dimensions given, there is plenty of room for the lid to clear filters two inches square.

THE best way to make filters is to mount regular filter gelatin between pieces of glass and bind the edges with tape. In doing this, always glue, at one corner and on the inside surface of one of the pieces of glass, a little piece of paper bearing the filter number or letter. Arrange the filters in the box in alphabetical or numerical order. Identifying figures or letters corresponding to those on the filter can be marked along the inside of the lid opposite the appropriate slots so that your filter can be readily selected without the danger of mistakes.

Here are a few biological stain formulas that you will find useful. If you do not want to mix them yourself, your druggist will do it; or he may have the solutions already in stock which will enable you to procure them at slight cost without going to the trouble of making them for yourself.

Loeffler's Methylene Blue solution:

Methylene blue 0.5 gram.
Alcohol 95%, 30.0 cc.
Potassium hydroxide 1/10 normal sol. 2.0 cc.
Distilled water 98.0 cc.

Dissolve the methylene blue in alcohol, then add the potassium hydroxide solution and the water. Another way of mixing the same preparation is to dissolve all of the methylene blue possible in thirty cubic centimeters of alcohol, add two drops of a ten percent solution of potassium hydroxide to 100 cubic centimeters of water, and mix.

Delafield haematoxylin: This is a standard stain for animal tissues, etc.

Haematoxylin 1.0 gram.
Alcohol (95%) 6.0 cc.
Saturated solution of ammonia alum 100.0 cc.
Glycerin 25.0 cc.
Methyl alcohol 25.0 cc.

For use, dilute ten to fifteen times with water.

IN PREPARING, proceed as follows: Mix the haematoxylin and alcohol and add the ammonia alum solution. Expose to light for a week, when the color will turn to a deep purplish hue. Then add the glycerin and methyl alcohol, and let stand two more days. Filter through paper. This is a stock solution that is diluted before use. When sediment forms, filter.

Eosin: This stain can be used in the form of a weak solution in alcohol or water. It colors bacteria and animal tissue red, and is generally useful for staining plant specimens.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

HE "CASHED IN" ON LOCAL CONDITIONS

FOUR years ago a friend of mine was earning a very comfortable living by making candy for one of the better known stores in the city. He had a steady position in congenial work, and the outlook seemed good. But then the depression came, and he went through the same reverses that millions of other men have had.

The company that he was working for was one of the first to fail. He lost his job, and during all the long years of the depression he was forced to struggle for a living. He found it especially difficult because he had been in a luxury business. But, like the western piano tuner who makes a living by tightening barbed wire fences, he was able to adapt himself to the changing conditions. He could still make candy; the problem, then, was to market it.

My friend's home is about midway between two high schools. He knew that after school many students buy candy or ice cream at the first store that they come to. If *he* could get to them *first*, the rest would be easy. So he started making candy at home, with his wife helping him. Then he purchased two small, portable stands which hold enough candy for a day's business and can be placed on the sidewalk or in any other convenient location.

Since then on every school day the two each load a stand with candy, take along some ice cream bars packed in dry ice, and then they separate, each going to one of the schools.

ON THEIR first day, when the students came out at the close of school, they found my friends right outside the entrance with all the popular candy and ice cream bars as well as their own home-made candy. Naturally enough they bought readily, feeling that they might as well buy there as any place else. Thus was started a small but thriving trade. Other students who normally remain after school for the various school activities and can not take time to go to a store for candy have become customers. A Model-T Ford, which is inexpensive and economical to operate, furnishes their transportation between the high schools.

They have added to their trade by making extra candy and selling it at their home. During the holidays they make special Christmas candy. They advertise weekly in the *(Continued on page 107)*

Secrets of Success

HE "CASHED IN" ON LOCAL CONDITIONS

(Continued from page 106)

school newspapers and have handbills printed for special occasions.

My friend is not making a fortune, but he is making enough to support his family and tide them over the depression. The idea has its drawbacks, for schools are open for less than two hundred days a year. Perhaps when better times come he will be able to get a regular position, but in the meantime his ingenuity is making him a living and is keeping him independent.—R. F., Cincinnati, Ohio.

• • •

FROM TEXT-BOOKS TO TOMATO JUICE

IN JUNE, 1931, Snead and Snead came home from college after finishing their sophomore year and began looking around for a vacation job. Home was Evanston, Illinois. Snead and Snead was a partnership dating back to high school days; the partners were Thornton, Jr., and Walter, twins; and the nature of the business had been anything from mowing lawns to selling Michigan fruit to Evanstonians. That year prospects did not look very bright.

One day, while in their mother's kitchen, they watched her making tomato juice from whole, ripe tomatoes that seemed to taste much better than the popular brands then on the market. Investigation and experimentation followed. They discovered that the tomato juice put up by most packers was really nothing more than a by-product. An idea was born. Why not use whole tomatoes, with all the rich pulp and juice combined, to make a delicious, health-giving beverage?

Snead and Snead wasted no time in getting started. They began working on fancy, ripe tomatoes from an Indiana tomato farm and soon had their product ready for the market. Morning Glory Tomato Juice, it was called. They distributed samples among their friends and neighbors in Evanston, and the unusual qualities of Morning Glory began selling itself.

Within three months from the time they bottled the first jug of the finished tomato juice, Snead and Snead moved from mother's kitchen to a small plant of their own. The infant industry had expanded much more rapidly than they had dared hope.

As their *(Continued on page 108)*

Secrets of Success

FROM TEXT-BOOKS TO TOMATO JUICE

(Continued from page 107)

product was different, so was their method of distribution. Morning Glory was placed in the refrigerators of the socially prominent families and the clubs and restaurants in and around Evanston. This was done through representatives who may be termed "socialites"—first locally, and later in the principal cities throughout the United States. They also employed the services of a few students, who introduced the product to colleges, universities, and various public institutions. There was no extensive advertising campaign, which would have meant unlimited expense, but a dignified selling system that was just as effective in putting the product across to the public.

In their plant the Snead boys now employ five persons with two truck drivers. in addition, for deliveries to freight stations and nearby points. Morning Glory representatives now number 168, besides the so-called "college group," which has grown from 15 to 200.

On January 1, 1934, having been in business less than three years, Snead and Snead was incorporated. As a confirmation of the success of their policy and the superior quality of their product, they point with pride to the list of stockholders, directors, and the extensive list of customers, which includes not only prominent individuals but schools, hospitals, clubs, hotels, and railroads in all parts of the United States.—J. C. J., Chicago, Ill.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

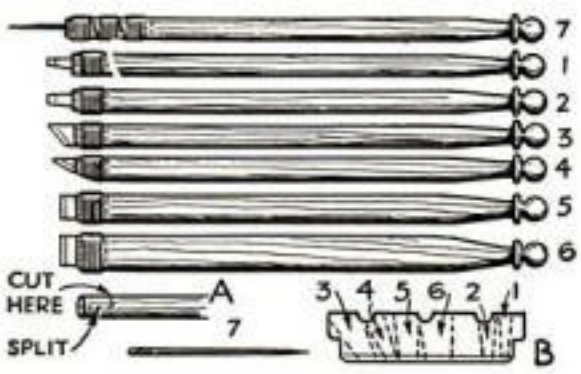
Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

RAZOR-BLADE TOOLS AID IN DELICATE CARVING

FOR delicate patterns on small ship models, for intricate inlays on small toilet articles and make-up boxes, and for small overlay initials and similar hand carving, I use a set of tools made from old razor blades. A pair of wide, blunt-nosed pliers will serve for breaking the blade. Be careful to have the sides taper so that they are a trifle narrower at the blade edge than at the handle, as shown at *B*. This is done so that when the wire is tightened around the handle, it will hold the blade securely.

The handles are whittled from cigar-box wood. After they have been roughed out, I



Set of miniature razor-blade tools for use when regular carving tools would be too big

make a cut across the handle, about ¼ in. from the blade end, and split the wood up to this cut, as shown at *A*. This split part is carefully sanded, the blade glued in (for convenience in handling), and the split piece put back into place. The entire end is then tightly bound with No. 22 gage enamel-covered wire. After the blade is in place, the handle may be trimmed, sanded, and enameled, lacquered, or finished in any manner.

Tools Nos. *1*, *2*, *3*, and *4* are for use on small carvings; Nos. *5* and *6* are used for cutting balsa wood to be used in airplane modeling, and No. *7* is a medium-sized needle for scribing and for use as a scratch point.

A 2-or 3-in. strip from an old razor strop, glued to a block of wood, serves to keep the blades in condition. A neat and convenient container for these tools was made from cigar box wood and patterned after the puzzle box illustrated in a previous issue (P.S.M., Nov. '32, p. 104).—E. P. HALE.

WATER GLASS HAS MANY USES IN THE SHOP

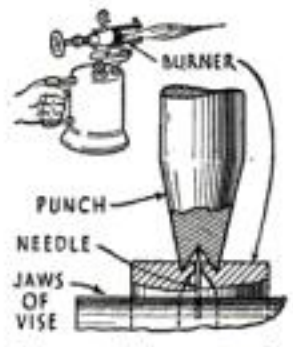
ALTHOUGH water glass (chemically, a solution of sodium silicate) is most commonly associated with the preservation of eggs, it is a cheap and useful material for many home workshop purposes. Used as a glue, it will fasten cardboard parts quickly and securely. It gives a glasslike protection to bottle labels to which it is applied. Photographs may be mounted quickly without wrinkles and are actually reënforced by this material. If it is applied in a thin film with a roller to the face of a dull photograph, it will impart a high gloss and dry in five seconds. Rubbed with a cloth into the surface of unfinished wood, it brings out the grain and at the same time acts as a quick-drying filler to which shellac or varnish can be applied immediately. It holds flat wood surfaces together tenaciously. When mixed with plaster for casts, it gives the latter a close grain and sheen that improve their appearance. A water glass and plaster mixture is also handy for temporarily recementing light bulbs that have come loose from their screw bases. A drop mixed with printing ink on the rollers of a card printing press will improve the quality of the work in some instances and hasten the time required for drying.—G. S. G.

REDUCING HOLE IN WORN BLOWTORCH BURNER

WHEN a blowtorch burner goes bad, the first aid it usually gets is an attempt to clean out the jet with a needle. After a few such treatments, the jet is enlarged, more gas comes through than can be properly vaporized, the flame turns yellow, and the burner is discarded as worn out.

On most burners, the jet can be reached with a simple swaging tool that will reduce the enlarged hole and make the torch burn like new. The work, including the making of the swage, is not difficult, and the result is well worth the trouble.

A center punch ground to a sharp 60-deg. point and a 4-in. length of ⅜-in. tool steel are required. With the steel upright in a vise, heat the end and make a punch mark in the center deep enough to be ⅛ in. in diameter. Chuck the piece in a lathe with the punch mark on the tail center, and taper the end at about 30 deg. down to the punch mark, leaving a sharp edge. Harden and draw to a brown, and smooth the edge on an oilstone. This outside tapering can be easily done on an emery wheel if a lathe is not available. The sketch, which is almost full size, shows a section of the swage and the work it does—that is, how it draws together the metal around the tiny hole in the burner of the blowtorch.



How tool is centered over the enlarged jet

Set the burner in a vise and start the swage with a guiding needle inserted through the channel occupied by the regular needle valve and through the jet. The hollow point of the swage, pressed against the guide wire, is brought accurately against the face of the jet by backing out the guide. To make the guide, select a straight sewing needle that is a good fit in the jet to be closed. Break off the eye and mount the sharp end in a round piece of wood loosely fitting the needle-valve channel. With the swage in position, strike a very light blow and see if the mark encircles the jet accurately; if it does, continue striking lightly, turning the swage between strokes, until a groove is formed around the hole and the inner cone of the swage has drawn in the edges of the jet to the proper size. While the swaging is progressing, the hole must be kept truly round and straight with the burner by burnishing frequently from both sides with a darning needle set in a small handle and used as an awl.

It is quite essential to the proper working of the burner that, when tested, the jet should throw a smooth, solid stream of gasoline straight through the center of the burner and several feet beyond. Be sure to lubricate the burnishing needle and work with a gentle hand.

In assembling the burner, use a paste of soap and graphite on the threaded joints. Be sure there is a free flow of gasoline through the wire gauze wick usually found in the tube between tank and burner. See that all carbon is bored out of the passages in the burner with the appropriate size twist drill. The point of the needle valve should be trued up and made very smooth. The last thing is to wash out the debris from these various operations and make sure again that the jet will throw a straight, solid stream of gasoline. The proper size for the jet can be found only by experiment as it varies in burners made by different manufacturers.—MAX CHARLES PRICE.

HOW UNCLE SAM'S SCIENTIFIC DETECTIVES SMASH KIDNAP GANGS

(Continued from page 17)

tapping apparatus failed to record the number being dialed. Thus, a detective would hear the conversation but miss the all-important information of the number being called. The new apparatus automatically records the number as well as the conversation.

The department also has the largest fingerprint file in the world. Nearly 5,000,000 malefactors are classified according to the distinguishing loops and whorls of the ridges on their fingers. In addition, there is a kidnaper's "Four Hundred," a selected group of prints representing known abductors and extortionists. This file holds 2,800 prints, the classifications being made on single fingerprints instead of on the basis of the ridge pattern of all ten fingers.

IN ONE case, a kidnaper went over the outside of an envelope after he had sealed it and removed every latent fingerprint. But, unknown to him, a single perfect print had been left in the softened gum under the flap. It was discovered by Federal detectives in the laboratory and helped convict the sender of the note.

A curious use of fingerprints in pinning evidence on a gang of snatchers figured in the famous Boettcher Case of Colorado.

Late on the night of February 12, 1933, a Denver, Colo., broker, Charles Boettcher, II, turned into his driveway. Leaving his wife at the wheel, he got out to open the garage doors. As he snapped on the lights, a man stepped from behind the machine with drawn pistol. "Stick 'em up!" he commanded, "This is a holdup."

Ordering Boettcher into a small dark-colored car, he left him guarded by a confederate and returned to Mrs. Boettcher, handing her a large envelope from which he ordered her to take a smaller one giving him back the outer envelope which contained his fingerprints. A moment later, the dark machine shot out of the driveway into the street. The note which had been left behind demanded $60,000 ransom.

Communicating with the abductors by tossing notes over a culvert on a rural road some distance from Denver, the father of the kidnaped man paid the ransom and on March 1, the captive was freed not far from his home. He related how his eyes were taped shut, how the car was driven around several blocks and then was headed in one direction on a run that lasted the rest of that night and all the next day. When it stopped, he was required to walk up twenty steps and then down some stairs again and into a basement.

LIKE Urschel, he kept his senses working, counting footsteps, estimating distances, listening for sounds that might tell him where he was. Also, unobserved, he put his fingerprints all over the room, under tables and chairs where they were not likely to be removed. And, later on, when clever detective work led the Federal investigators to the South Dakota ranch of the outlaw, Verne Sankey, the discovery of these fingerprints offered proof positive that it had been the hideout of the gang.

While awaiting trial in a Chicago cell, Sankey committed suicide, hanging himself with his necktie.

While the Lindbergh Law was passing through the House and Senate, the ace detectives of the Department of Justice, were being called to Washington in small groups. For weeks, they were given intensive training to fit them for their new work. Curious courses sharpened their wits and helped them outsmart the abduction gangs.

They studied footprints and broken glass, inks, and tiremarks, papers and bullets. They worked with ultra-violet lamps and comparison microscopes. At Fort Meade, Md., they underwent advanced instruction in the use of firearms and gas guns. Only three "G men," as government sleuths are known in the underworld, have been killed since 1908. The implacable man hunt which followed each case has impressed the idea that escape is impossible for the murderer of a detective of the Department of Justice.

Every one of the 350 operatives in the service is a graduate lawyer with the exception of the men who work on bank cases. They are expert accountants. Rhodes scholars and graduates from almost every university in the country make up the force. It is the cream of the law enforcement army of the nation.

The country is divided into twenty-five sections with a field officer and a group of special agents under him in each division. There is no working at cross purposes. Each group, in constant telegraphic touch with Washington, covers its own territory so a minimum of time is lost in travel. Some months, as many as 15,000 cases, no two alike, are investigated by these hard-riding government detectives. Trained to know the value of evidence, they are able to present such airtight testimony to juries that, Hoover told me, they have established the almost unbelievable record of ninety-five percent convictions in all cases that come to trial!

IN THE Luer kidnaping case of Illinois, when the "Dice Box Kid" and his gang abducted the seventy-seven-year-old Alton banker, August Luer, and kept him for days in a tiny underground room, the Federal agents cleaned up the crime and saw six members of the gang on their way to the penitentiary, three for life, in less than sixty days.

To help in abduction and extortion cases, the laboratory of the Washington crime hawks includes the largest collection of papers and watermarks in the country. Nearly 25,000 kinds of paper is on file and as each new watermark is registered at the U. S. Patent Office, a copy is added to the collection at the Department of Justice laboratory. Inks and specimens of typing from practically every known make of typewriter are also stored away for ready reference.

Last fall, when a typed note reached Dr. Albert Fritz, New York physician, threatening harm to his children unless he paid $10,000 to the writer, this reference collection enabled an expert of the crime laboratory to report almost immediately that the note had been written on a dial typewriter of the sort used by children.

A check of all the doctor's patients revealed that one, John Isola, had a criminal record. He roomed with a family including a small boy who owned a dial typewriter. The boy's mother remembered that Isola had once borrowed the machine. A comparison in the laboratory proved that the threatening letter had been written on it. Isola went to prison for ten years.

ANOTHER valuable aid in the work of Federal sleuths is a collection of blueprints showing the treads of practically every known make of tire. When "Taters" Raymond and his accomplices abducted George N. Davis, a retired industrialist of Lewisburg, W. Va., last year, holding him for $10,000 ransom, the tire prints of the car they used formed an important clue in the early stages of the investigation. In the DeJute kidnaping in Ohio, the fact that tire marks showed that the wheels of an automobile had been spinning in a hasty getaway figured as a link in the chain of evidence which sent three men to prison. (Continued on page 112)

HOW DETECTIVES SMASH KIDNAP GANGS

(Continued from page 111)

Small clues are probably more important in trailing snatchers than in almost any other crime. In kidnaping, there is no bullet, no bloodstains, no body, as there is to help the sleuth unravel a murder mystery.

In one instance, a boy abducted in an eastern city, could give no idea of where he had been held. The only thing he could remember was that from a small window he saw boys playing around a khaki pup tent in a vacant lot. Running down that slender clue, detectives checked off every vacant lot in the city, found one where boys had had a tent, canvassed the neighborhood, discovered the room where the boy had been held captive, gained a description of the two men who had rented it, and ran the kidnapers to earth.

NOT long after the mysterious death of Smith Reynolds, young tobacco heir, his two-year-old daughter by a first wife was threatened with kidnaping. The child's grandfather, Joseph F. Cannon, a wealthy mill owner, received letters signed "THE FOUR MUSKETEERS." They directed him to leave $20,000 on the upper shelf of a china closet in a vacant house at Hapesville, Georgia.

Government men sped to Hapesville. They went over the territory and, working at night with flashlights taped so they gave forth only tiny needles of illumination, they installed electrical apparatus which would enable them to follow, from a distance, the movements of anyone entering the house and would give an alarm if the ransom package was disturbed. Floodlights stood ready to flare up at the throw of a switch. A high-powered car, manned by two of the agents, stood in a garage near the vacant dwelling and a small army of police, armed with sawed-off shotguns, revolvers, and automatics, was standing by for the signal.

With the trap thus set, an advertisement was inserted, as directed, in a local paper and the money was left in place. For three days and three nights, the men kept vigil, one Federal sleuth on a rooftop scanning the sky with powerful binoculars and noting down the number of every passing plane, another jotting down the licenses of all automobiles driving through the neighborhood.

ON THE fourth day, a well-dressed young woman strolled up to the vacant house and entered. Their electrical apparatus told the waiting agents what she was doing. She pulled out the lower drawer of the china closet, stood on it and took down the package containing the money. Arrested before she could leave the house, she said she was Mrs. Sue Boyles, wife of a parachute rigger at a nearby airport. She maintained she was simply carrying out a request to get the package for her husband and had no idea what it contained. Boyles was taken into custody. He was fingerprinted and found to be an ex-convict. Evidence pinned "The Four Musketeers" plot to him and he went to the penitentiary to serve a fifteen-year sentence.

Time and again in their spectacular work of smashing kidnap gangs, the Federal agents have turned to the aid of apparatus and the laboratory. The results they have obtained is a triumph alike for the skill of the government men and for the effectiveness of clues unearthed by science.

HOW THE SUN AND MOON ARE ECLIPSED

(Continued from page 51)

umbra. The gray shadow ring surrounding the umbra is the penumbra.

An observer at any point on the earth's surface within the umbra will see the sun totally obscured. At any point within the penumbra, the eclipse will be partial.

To test the truth of this, make two holes through the card representing the surface of the earth in the illustration. Make one anywhere in the umbra. Make the other anywhere within the penumbra.

Then place the eye at each in turn. When the eye is at one hole, the golf ball entirely obscures the lamp, as shown in the diagram. When the eye is at the other hole, the golf ball only partially eclipses the lamp bulb.

One of the diagrams also shows how the rays of light from the sun criss-cross around the moon and enclose the long narrow cone of shadow which produces a total eclipse when its end is cut by the earth's surface.

IF THE moon revolved around the earth in exactly the same plane in which the earth travels around the sun, total eclipses of the sun would not be as rare events as they are. In fact there would be some kind of a solar eclipse every month. The reason total solar eclipses are rare is due to the fact that the plane of the moon's orbit slants slightly to the plane of the earth's.

There are also two other interesting conditions which modify the occurrence and character of solar eclipses. They can both be covered by the statement that the orbits of both sun and moon are not perfect circles, but extremely short or fat ellipses. And neither sun nor earth is at the center of the ellipse, but considerably to one side of the center.

In the case of the earth's orbit, the off-center position of the sun causes a decided variation in the length of the shadow cone, or umbra, cast into space by the moon. The average length is 232,000 miles. Let us see how the length of the cone varies when the earth changes its position in its orbit.

For example, when the earth is nearest the sun, the length of the moon's shadow is one-sixtieth less than the average. And when the year has advanced until the earth is farthest from the sun, the shadow cone will be one-sixtieth longer than the mean length. You can see that this would make considerable difference in the width of the path of totality and the length of time totality lasts.

THE result of the off-center position of the earth in the moon's orbit leads to an entirely different result. If an eclipse occurs when the moon is at a node nearest the earth, the eclipse will be total. Why? Because the moon is slightly nearer us and obscures the sun completely.

But if an eclipse occurs with the moon at a node farthest from the earth, the eclipse will be "annular." In other words, the moon, being farther away, and smaller, will leave a ring of the sun's disk showing around the black disk of the moon.

So far we have considered only eclipses of the sun. These necessarily occur at new moon, but lunar eclipses happen only when the moon is at full.

Eclipses of the moon are not spectacular, and are slow-moving, for the moon sometimes takes four hours to pass through the earth's shadow-cone, which is about 5,700 miles in diameter at the point where the moon plunges through it.

Ever since about 800 B.C. there has been a period called the "saros," by which the return of eclipses can be roughly predicted.

Solar and lunar eclipses can both be predicted by means of the saros, but only roughly as to the actual time and place.

WHOLE WORLD NOW A MOVIE STUDIO

(Continued from page 33)

up. It stuck out like a sore thumb in the otherwise primitive setting. So Shackelford covered it with palm bark, stuck on fresh leaves and turned it, to all appearances, into a coconut tree! Fish nets, hung around the trunk, hid the straight lines, adding to the illusion.

In filming "Four Frightened People," Cecil B. de Mille searched the Hawaiian jungles for a location until he found what he wanted at the bottom of a hidden canyon, 200 feet deep. He lowered cameras and lights on ropes to make test shots. In some places, the undergrowth was so dense that men could walk safely ten feet above the ground. Players could not reach the location until a long stairway had been built; and cameras, batteries, and lights were slid down a wooden chute to the floor of the canyon.

THE generators which supplied the current for the work were left on the edge of the slope, half a mile away. The actors rested and changed costumes in floorless dressing rooms brought in crates from Hollywood. Three men could set up one of these demountable houses in five minutes, simply by bolting the walls and roof together. The door was built into the front.

Three miles up the side of the volcano, Mauma Kea, the director found a dense forest, perfect for the effect he wanted. In a few days, workmen had cleared a road three miles long, filling in crevices with twenty tons of cane pulp. Tractors daily hauled players and equipment to the scene in cars and cane wagons. Two days after work began, telephone wires had been strung and members of the party were talking with the Hollywood studio, 2,400 miles across the sea.

For many of the scenes, camermen found it impossible to obtain soft color tones until they had created a screen of black gauze through which the cameras recorded the harsh lighting of the tropical background. The gauze, invisible on the film, diffused the brilliant tropical sunlight and produced the softer effects desired.

Metal reflectors now replace glass mirrors for concentrating light on out-of-door scenes while they are being filmed. Forty of these nonbreakable reflectors accompanied de Mille to Hawaii. In the tangled bamboo jungles where many of the scenes were shot, however, sunlight rarely penetrates. For that reason, the company carried twelve kinds of artificial lights to give some semblance of day to the perpetual gloom.

WHEN another company made an expedition to the tropics, all the filming was done at night. The heat and humidity of the daytime were thus avoided and better films were the result.

Many location trips to out-of-the-way places in America require special preparations, with equipment that can be easily transported and which is designed for particular conditions. In filming "Laughing Boy" in Arizona recently, the studio shipped sound trucks by railroad to the town nearest the location. From here, they continued under their own power. At the same time, the cameras and lighter equipment crossed the desert from Los Angeles by motor truck.

Every item carried on a film expedition to a distant part of the world must be reduced to its minimum weight. Recently a studio engineer designed a big electrical generator which can be broken down into four units of 300 pounds each. Sufficiently powerful to supply current for the sun arcs, which are used even along the equator, it can be transported to otherwise inaccessible regions by airplane.

FACTS REVEALED BY HOUSEHOLD DRUGS

(Continued from page 57)

water. This can be shown by holding a burning strip of magnesium ribbon inside the open mouth of a flask or beaker of boiling water. The metal, held in the atmosphere of steam, will continue to burn.

To prove that the magnesium actually was burning in the steam, stealing the oxygen necessary for its combustion from the water, repeat the experiment using a lighted match instead of the burning magnesium. Unlike the magnesium, it will be extinguished.

Magnesium can be made to combine with nitrogen as well as oxygen. The product of such a reaction, of course, will be magnesium nitride rather than magnesium oxide. To perform such an experiment, the home chemist can take advantage of the nitrogen in the air by tightly packing some of the metal in a covered crucible and heating it for a half hour over a gas burner. When the fused mixture that results has cooled and is broken open the top portion or crust will prove to be white magnesium oxide. Beneath this, however, will be found a yellowish mass of magnesium nitride. To test the magnesium nitride, place a few drops of water on it. Ammonia gas, instantly recognizable because of its odor, will be given off.

LIKE most metals, magnesium can be made to alloy or combine with mercury to form magnesium amalgam. Unlike most common amalgams, however, it will start a curious reaction when dropped into water, decomposing the water to liberate hydrogen and form magnesium hydroxide.

The home chemist can prepare such an amalgam simply by cleaning a strip of magnesium ribbon with emery cloth and allowing it to remain in contact with a small globule of mercury for an hour or so. At the end of this time, the two metals will have become sufficiently alloyed to perform the experiment with the water.

MAGNESIUM amalgam also can be made quite readily from powdered magnesium. Simply place a drop or two of mercury in a mortar, add some magnesium powder or ribbon, and grind the powders into a fine mixture. Soon a sticky, pasty mass will be formed. This is a magnesium amalgam which, if left exposed for any length of time, will decompose the moisture in the air to form hydrogen and magnesium hydroxide.

Although most compounds of magnesium are white, the queer properties of magnesium chloride offer the home chemist a novel experiment in chemical colors. First, some magnesium chloride is melted in a crucible, an evaporating dish, or the shallow friction top of a tin can. The chemical will melt easily in its own water of crystallization.

In this molten condition, it will dissolve many different chemicals and metallic oxides to form beautifully colored molten masses. For instance, when tiny bits of cobalt sulphate are added they will produce a soft blue tint. Nickel sulphate dropped into a fresh batch of the molten chloride will form a deep purple color. A small crystal of copper sulphate will produce a brown. In each case, the color produced is a mixture of magnesia and the oxide of the metal used.

Magnesium chloride has another curious property that makes it an interesting substance from the home chemist's standpoint. When heated, it breaks down, decomposing to form magnesium oxide, hydrochloric acid, and water vapor (steam). The unmistakable odor of hydrochloric-acid gas will be evidence of the reaction and the fact that moist blue litmus paper will turn red will prove that an acid gas is being liberated.

SAVING DOLLARS WHILE DRIVING YOUR CAR

(Continued from page 64)

"We won't bother about names—just figures," he suggested as he lifted out one of the cards. "For instance, here's a six-cylinder car, a 1930 model. During '31, the only repair was a carbon job. In '32, the brakes were adjusted, the clutch repaired, new exhaust valves installed, and a whole new set of spark plugs was put in. In '33, the car had a rebore job, new rings, new connecting rod bearings, and a new set of tires. So far this year, the car has been in here only once, and that was for a frozen radiator. All in all, the car has cost over two hundred and twenty-four dollars for repairs in four years."

"Phew!" exploded Walton. "Expensive car, I'd say. Glad it isn't mine."

Without answering, Gus fingered through the cards again and selected another.

"NOW, here's the same make car, same model, but owned by another man. The mileages are just about the same on both. In 1931, he had a general check-up of the ignition system, carbureter, valves, and brakes in May and again in October, radiator flushed in April and November, and tires switched to different wheels in December. During '32, chassis inspection, two general check-ups in the spring and fall, valves resurfaced and adjusted, bearings tightened, and breaker points adjusted. Under '33, the usual two check-ups in spring and fall, two new tires, and new brake linings. So far in '34, the car hasn't been in."

"Gosh," broke in Walton when Gus had finished, "that second car was in here more than the first one."

"Right, but it didn't cost as much in the long run," said Gus. "All together, the three-year bill for that second car totalled only ninety-three dollars, including the tires. That owner believes in paying for prevention instead of cure. A check-up twice a year doesn't cost much and it keeps the general condition of the car up to par. It's cheaper to adjust bearings than to replace them."

"I've never looked at it that way," Walton admitted. "A repair shop to me has always been something to keep away from unless it was necessary. I don't know, but I've always had an idea that some garagemen take advantage of every chance to make money."

Gus smiled. "Some garages are that way," he agreed. "It's been claimed that car owners waste billions of dollars a year by dealing with gyp garages. That's why it pays to locate some honest service station and give it all your work. You wouldn't trust your life to a quack doctor, so why place your car's health in the hands of some crooked mechanic?"

"ISN'T there some way an untrained person can tell if a garage is overcharging him?" inquired Walton.

"It would be pretty hard to make any fast rule on general work," Gus advised. "But with repairs, where parts have to be replaced, it's safe to figure about a dollar's worth of labor for every sixty cent's worth of parts."

"Well, in about four months I'll bring this car of mine in and let you go over it," said Walton as he climbed into the driver's seat. "Maybe there is something to this business of an ounce of prevention being worth a pound of cure."

"Weren't you just wasting your breath telling that fellow how to take care of his car?" Joe Clark remarked as Walton drove off. "He never wants to spend any money unless he absolutely has to."

"It may help some," Gus said, and then added with a grin, "The Model Garage would have a tough time making ends meet if every customer on our list treated his car the way he should."

PHANTOM RACE HORSE PRODUCED BY SCIENCE

(Continued from page 19)

this, the breeding and racing records of 10,000 thoroughbreds in the United States, Canada, Great Britian, Australia, and other countries were systematically compiled. A folder was opened for each of these animals, and in it was filed its complete breeding and racing records. If the subject was a stallion, the names of all the mares by which he had produced offspring were listed, and the racing capacity of each of the foals noted. If a mare, each stallion by which she had produced foals was listed, and the racing capacities of the foals noted.

WITH all this information available, the racing record of each horse was analyzed carefully. In determining racing capacity, only races truly run on good or fast tracks were considered. In fact, it was found that a truer picture of the horse's ability could be obtained if only the best of his races were considered, since nothing can make a race horse run faster than his racing capacity, but there are a number of things that, honestly or dishonestly, can slow him up. So if a horse had started in six or seven races that were truly run on good fast tracks, five of them were used in getting the mathematical picture of his racing ability. If he had run between thirteen and fifteen races, eight of them were considered. If he had run twenty or more races, ten of the races were used in computing ability.

Using each horse's best races, his "quality of performance" in each of them was found by comparing his average speed in each race with the seconds-per-furlong speed of the Standard Horse running under the same conditions of distance, age, and weight carried. If the horse under consideration ran the distance in time equaling the "par" established by the ghost horse, his quality of performance was rated 1.000. If he beat the Standard Horse's time, he was given proportionate points over 1.000. If his time was slower than the ghost horse's, his Q. P. rating was proportionately under 1.000.

At the top of the list of scientifically rated thoroughbreds stands the name of the best horse of them all, Man o' War.

This big red chestnut with the broad chest and the long back, a perfect specimen of a thoroughbred, has a Biological Handicap of 139.25 "pounds." In his two-season competitive career that included thirty-three minutes of actual racing, he won all but one of his twenty-one races. That one defeat by Upset was caused by a bad ride, and was revenged by three victories over the only horse that ever led him under the wire.

BUT, greatest of horses though he is, Man o' War's racing record is not marked by extreme consistency. The average quality of the nine best of his seventeen truly-run races is 1.0115. In his very best race he had a Q. P. rating of 1.0221. If he had been able to maintain the level of that marvelous performance he would have had a Biological Handicap of 146.82, and, as Dr. Laughlin remarks, "no horse ever was that good." In his poorest truly run race on a good track, Man o' War earned a Q. P. of only .9545. If he never had bettered that performance he would have been a very mediocre race horse. Great as he was, Man o' War wasn't as great as the "imponderables" of horse racing. He wasn't always able to produce the best performances of which he was capable.

Two other horses are rated almost as high as Man o' War. One of them is Eclipse, who was foaled in England at the time of the great eclipse of 1764, and whose sons and daughters won 334 races. The other is St. Simon, another English thoroughbred of long ago. There is a dash of St. Simon blood in the veins of Man o' War.

When the thoroughbred is compared with other breeds of horses, its inherited racing capacity seems to be a remarkably uniform quality. But within the ranks of the thoroughbreds, now closed to all outside blood, racing capacity is far from being a uniform quality. To improve the breed, to produce race horses that can run faster and carry heavier weights for longer distances than the best of our present-day race horses, there must be really scientific breeding.

To provide an accurate guide for such breeding, Dr. Laughlin has worked out a mathematical method of forecasting the probable racing capacity of a foal of any stallion and mare. He calls it the Futurity Index.

Experience has proved that this Futurity Index will be more nearly accurate if it is calculated from the racing records of a group of the nearest direct and collateral blood kin of the sire and dam than if it is worked out by tracing descent along a few ancestral lines. In calculating the Futurity Index equal value is given to the "breeding factor" of the sire and the dam. In figuring the breeding factor of the sire, consideration is given to his racing capacity, to the racing capacities of his sire and dam, and to the racing capacities of the foals he already has produced. The breeding factor of the dam is calculated in the same way. These two breeding factors are combined to form the Futurity Index of the foal.

IN THE best breeding establishments only the cream of the thoroughbreds are dealt with—sires and dams with near kin of proved high racing capacity. With such stock the Futurity Index of the foals is very high. For example, for forty-two racing foals bred at one famous farm it averaged 116.1. But the average actual racing capacity of those foals was strikingly lower—97.75.

Studies in heredity had led Dr. Laughlin to expect this. But the apparently disappointing result has a counterbalance. If sires and dams of sound thoroughbred stock, but of lower racing capacities than the top notchers of the breed, are selected, and the Futurity Indices of their prospective foals computed, the Futurity Index values will be low. But the actual racing capacities of these foals will be higher than those of their parents. Whether the sires and dams are the leaders of the thoroughbred world, or rank among the minor nobility of that equine aristocracy, most of their foals will swing down or up toward the average of the breed.

This "regression phenomenon" is characteristic of all breeding experiments with stock of measured quality. Just how much this drag toward mediocrity amounts to in pulling down the offspring value of exceedingly superior parents, and in raising the offspring value of inferior parents, when all are drawn from the same breed, is one of the problems that Dr. Laughlin's researches have solved.

ALTHOUGH offspring of the best of any breed are more likely to fail to equal, than they are to exceed, the capacities of their parents, still occasionally a foal will equal the promise of its Futurity Index, or even exceed it—and the selection of these few shining successes among many comparative failures gradually will improve race horses.

So the Standard Horse, the ghost entry that runs in every race, leads the thoroughbred field into the future. Challenged often by his flesh-and-blood rivals, he is beaten only occasionally by some champion of champions like mighty Man o' War.

SLANTING OIL WELLS WORK NEW MARVELS

(Continued from page 41)

the perpendicular, out of control of the driller. It was not uncommon for a 5,000-foot hole to end its course 1,700 feet out from under the derrick!

Drillers learned how crooked their wells were when new instruments were devised to chart the hole. Bottles containing hydrofluoric acid were lowered into the hole and allowed to stand until the acid had eaten into the glass, etching a mark which showed how much the hole was tilted. Later, elaborate machines were devised, which could be run up and down to produce a written or photographic record of the whole course of the well.

WHILE engineers have been perfecting new methods of drilling straighter, a new school of experts has arisen who are reversing ordinary procedure by purposely drilling on a slant. Their operations caused a furore.

Recently, rumors of such drilling sent state oil sleuths secretly investigating fifty mystery wells that were being drilled along the coast of California. Suspicion was aroused when, in the middle of an old, dying field, a new well suddenly roared into life with a heavy flow of oil. Old wells adjoining were nearly lifeless and had to be pumped. Soon a whole series of gushers burst into heavy production.

Geologists were astonished. They knew the old field was nearly exhausted. Another and richer oil sand was known to underlie the ocean, but it was separated from the old pool by a fault. Had the mystery wells crossed the fault, to penetrate this submarine zone?

Drillers were tight-lipped and uncommunicative. State operatives did under-cover investigation. Suddenly a veritable bombshell was exploded. The owners of all fifty wells were brought into court and charged with mechanically deflecting their wells out under the ocean and filching oil from publicly-owned tidelands at the rate of some fifteen million barrels annually.

To reach the submarine pool, drillers of the new wells had to drive their bits almost 1,000 feet seaward, crossing under a strip of beach land owned by a large oil company. Soon two old wells in this strip along the ocean were pierced by the bits of drilling wells. Little doubt existed that all fifty wells were aiming at the rich store of oil underlying state property.

As this is written, the case is still pending, while state officials and officers of the oil companies involved are trying to reach an agreement whereby the slant-drilled wells will be allowed to tap the pool if they pay a royalty percentage into the state treasury.

THE newly developed technique of slant drilling may be utilized to develop unexploited fields in inaccessible locations, or to reduce the number of holes that must be drilled to drain all the oil from subterranean storage. In some localities, the cost of erecting a suitable foundation for an oil well is almost prohibitive. For example, in parts of Venezuela, where the oil underlies deep lakes or bays, the cost of making a suitable foundation is greater than the whole drilling cost of the well. Simply by drilling along the shore, and deflecting the bit out under the lake, this huge expense may be saved.

A revolutionary scheme for reducing the number of wells necessary in an oil field, has been proposed by an expert who suggests that each well be used as a center for four or more holes, all drilled from one derrick but diverging at the bottom so as to drain a large territory. Each territory would thus be the nucleus of four or more pipes, each corresponding to an ordinary well. Such a system would greatly reduce the cost of developing an oil field, and make it much simpler to pump.

DEADLY SNAKE POISON NOW USED TO SAVE HUMAN LIVES

(Continued from page 30)

and the rattlesnake both strike, stabbing the flesh of their victims. The cobra, with its shorter teeth, suggesting stubby rose thorns, chews after it strikes, drenching the wound with venom and making a number of incisions.

Armed only with a slender rod about two and a half feet long, having a short crosspiece at its head, Ditmars moved quietly to the table. The stick was just long enough to keep his hand a few inches beyond the farthest reach of the fangs. As the moccasin lay quiet for an instant, he pinned its head to the table and grasped the scaly neck just behind the jawbones. His fingers were hardly an inch and a half from the curved fangs in the wide-open mouth. An assistant held the body of the snake from coiling around Ditmars' arm. Even a momentary loosening of his grip would allow the twisty snake to turn its head and sink its fangs into his hand. And if these hollow teeth inject their poison into a vein, even antivenom may be powerless to save the victim's life.

LIFTING the head to the edge of a heavy-bottomed tumbler covered with tightly stretched gauze, Ditmars plunged the teeth through the cloth. A contraction of the muscles above the jawbones forced out twin jets of poison. In the bottom of the glass it looked like orange juice. Some snakes carry more than 100 times the venom required to kill a man. When Ditmars finished massaging the head above the venom sacs to force out all the poison, more than a teaspoonful of the brightly-colored liquid covered the bottom of the glass. He lowered the head to the table and released it with a quick upward flick of his hand.

That last moment when the snake is released is a critical one. A few years ago, Fred Taggart, one of the keepers at the snake house, finished removing a bit of skin from the eye of a copperhead which had had trouble in shedding. As he dropped the snake to the floor of the cage, it shot upward like a rubber ball, driving its fangs into a thumb. Fortunately antivenom was available and a quick injection saved his life.

The first antivenom was made by Dr. Albert Calmette, at the Pasteur Institute, in Lille, France. He was also associated with some of the early work of Dr. Monaelesser. Today, there are well-established snake farms and antivenom laboratories in various parts of the world. The first of these was established near Sao Paulo, in Brazil. The work was begun as a hobby by Dr. Vitalo Brazil and was later taken over by the government. At Tela, Hondurus, another snake farm provides serum against the poison of Central American snakes and at Bankok, Siam, a laboratory turns out antivenom against serpent bites in the Old World. A snake farm at Glenolden, near Philadelphia, Pa., supplies the antivenom for North America. The laboratory at Port Elizabeth, where the work in venene and its use in epilepsy has been carried on, is responsible for combating venomous snakes in Africa.

EVERYONE who catches a poison snake in Brazil is required by law to forward it to the Sao Paulo farm. Railroads transport the containers free of charge. Mail time at the farm is the most exciting period of the day as an average of twenty deadly snakes arrive with each delivery.

The method of preparing the antivenom is relatively simple. The extracted poison is diluted with salt water and bit by bit injected into healthy horses under the skin of the neck. Each dose is larger than the preceding one. At the end of six months, the animal can stand shots of venom fifty times as powerful as would have been required to kill it when the injections began. What happens inside the horse is another mystery. In some way its blood manufactures an element which combats the poison. At the end of six months, eight quarts of the animal's blood is drained off painlessly and placed in sterilized containers. The blood clots and an amber-colored serum forms.

CONCENTRATED and sterilized, it is put up in glass tubes, sealed at both ends and containing about three teaspoonfuls. The tubes sell for ten dollars apiece, and are labeled according to the type of venom they are able to combat. The fluid remains effective for five years or more. The antivenom is injected by hypodermic needle into the stomach muscles of the victim. In North America, antivenom is made by injecting a mixture of rattlesnake, copperhead, and moccasin venom into the laboratory horses.

Before antivenom was available in America, a United States army officer, Col. Martin L. Cummins, while stationed in Texas, built up partial immunity to venom by small injections over a period of years. As a result, he was able to save a number of lives through transfusions of his blood into the veins of bitten children. Because his life stream had developed the power to combat the snake poison, it acted in the veins of the victim much as antivenom does.

At the Sao Paulo farm, in addition to preparing antivenom, the experts are combating poison snakes in another way. They are raising massarambas, powerful non-poisonous black snakes that attain a length of eight feet and live on fer de lances and other dangerous serpents of the country.

Another attempt to use the natural enemies of snakes has proved less successful. The mongoose, which kills the cobra in the Orient, has been imported into Central and South America at various times. While able to avoid the darts of the cobra, which rears up and fights high, the mongoose is less able to sidestep the low-striking snakes of the new world. Contrary to general opinion, these animals are not immune to poison. They are simply quicker than the cobras. While some creatures are less susceptible to snake venom, the frog, for instance, being able to stand twice as much rattlesnake poison as the guinea pig, so-called immune animals are usually either quicker than the snakes or have thick hides which the fangs do not penetrate.

DURING one series of the medical experiments, it was found that dried venom retains its potency for many years. One sample five years old showed practically full strength and another twenty years old proved to be highly active. Dr. Monaelesser found that light quickly decreases the toxic effect of dried venom. In cases in which he desired to reduce the power of the cobra poison, he subjected it to a treatment of X-rays before preparing it for injection. Another fact discovered is that the venom of North American snakes is most poisonous in the spring when they come out of hibernation.

In various parts of the world, free lances are engaged in the risky business of catching snakes and selling venom. One of these adventurers, W. E. Jones, has spent thirty-five years in the heart of Zululand destroying puff adders, mambas, and cobras, sending the dried venom out to various laboratories.

Looking ahead, experimenters are now preparing not only to counteract the effects of deadly venom, but actually to use it in fighting disease. To the hundreds of thousands of victims saved by antivenom, they hope to add other thousands brought back to health by dramatic new applications of reptile poison.

RACING HOMEMADE MIDGET AUTOS

(Continued from page 28)

ciation, and signed up the eligible drivers.

He started the racing, and drivers began to flock in. The idea caught on like wild fire. A few hundred people witnessed the first events at Loyola, an athletic field hidden behind the high green fences back of Loyola high school. Soon Distarce was packing 'em in. As many as 7,000 people have crowded into the field during a single evening.

Distarce told me he planned from the outset to do two things: give the public thrills without constant danger to the drivers and limit the speed of the cars to a point where the boys would not break their necks every time they raced. He requires all cars to appear at the tracks in a presentable condition and to meet the approval of critical inspectors. The drivers must show up in clean uniforms with helmets to match. But the most important regulations apply to the cars.

They stand only twenty-six inches in height, have a tread of forty-two inches and weigh from 500 to 850 pounds. They cannot use superchargers and piston displacement is limited to 100 cubic inches. Only one carburetor may be used, and automatic or pressure type fuel injectors are strictly taboo. These rules apply to four-stroke cycle motors. As for two-stroke cycle engines, anything goes within the limit of sixty-one and one-half cubic inches of piston displacement.

LIKE their big brothers of the more famous tracks, these little fellows are equipped for quick "cut-off" in case of trouble. Fuel systems and electrical circuits are provided with shut-off devices, short-circuiting buttons, and switches within easy reach. The drivers are warned to keep their head above their cowls and always to keep a sharp lookout for other cars. Tommy Phillips, ducked to look at his oil pressure gauge the other night. Before he came up for air, he had run over the rear left wheel of "Red" Frick's car, turned three somersaults, and came to rest upside down.

His first question, when he regained consciousness in a hospital, was: "Can I get 'er fixed up to run next week?" The next Thursday he was racing again!

These rules, which the Association invokes on all comers alike, will give you a clearer idea of these tiny speedsters:

Wheelbase may not exceed seventy-six inches nor be less than sixty-six inches from axle to axle.

Tread may not exceed forty-five inches nor be less than forty inches.

Wheels may not have a rim diameter greater than twelve inches nor less than ten inches.

All cars must be equipped with flexible, spider-type steering wheels and suitable brakes, with a fire-proof wall between driver and engine.

All cars must carry manually operated clutch, and exhaust pipe extending beyond the rear axle housing.

All cars must carry a gasoline tank constructed of eighteen gauge material.

All cars must have a road clearance of four inches or more.

SCRAPBOOK OF AIRPORTS FOR GOVERNMENT FLYERS

A SCRAPBOOK of airports is a unique volume being compiled by the pilots of the government flying base, Maxwell Field, Montgomery, Ala. The book will include photographs, taken from various angles, of the main flying fields of the country. It will enable pilots flying to strange airports to get a mental picture of the landing field.

Raising Tropical Birds for Fun and Money

(Continued from page 37)

window, but as they play and make love when they are not aware of an alien present.

Bear in mind always the comfort of your tenants. Be sure to have the cage or aviary ready for occupancy when your birds arrive, and also to have seed pans and drinking cups placed in the most conspicuous places to make sure the timid little creatures will find them. It is well to have an extra supply of each placed near the perches, since some varieties may not come down for food during the first few days.

Provide the newcomers with distilled or boiled water for a day or two, then change gradually to your usual local supply. This will prevent diarrhoea. Cover the bottom of the cage with clean newspaper. Do not overlook the grit. It serves as the birds' teeth and is necessary to thorough mastication of food. A little grit on the floor helps also to keep their feet clean. Always keep a piece of cuttlebone fastened to the cage off the floor, but within easy reach. This does not serve to sharpen their beaks, as so many people think, but is a valuable food.

Birds are very much like young children when their routine is upset. Stay away from the new arrivals until they have rested from their trip, no matter how short it may have been, and keep them quiet and out of drafts. The room should be kept at a temperature of eighty to eighty-five degrees, Fahrenheit, until they become accustomed to their new habitat, even though they may be able to withstand very low winter temperatures. Throughout the year it is a good plan to cover the cage at night with a cloth, light in summer and heavy in winter, since in restricted quarters they do not take enough

As far as known, this is the only pair of laughing jackasses in America. Native to Australia they were imported after birth

exercise to keep themselves warm. Again, like children, they have their peculiar preferences. Most of the finch family like to sleep in little nest boxes or gourds and you will make them happier by supplying these conveniences. The gourd may be prepared easily by rounding out on one side a hole large enough to permit ingress and egress, and placing nesting materials within.

When the little creatures become accustomed to their new home you will witness a busy, happy family. Give them surroundings they like and they actually will improve their own strain.

For best results in cage breeding, a proper cage must be provided. It should be constructed entirely of metal, as this type is sanitary and easily cleaned. For a single pair of small birds, a cage measuring sixteen inches by ten inches by nine inches deep will be large enough. Place it where you expect it to stay, and do not thereafter disturb the mates except when absolutely necessary. Give them a nest box or gourd with plenty of nesting material and put a white cloth

This practical food hopper for an outdoor aviary has room for grit, nesting food, and seed

around the sides and top. Feed the proper seed mixture, cuttlebone, health grit, and water daily.

Birds may be bred also in the large, outdoor aviary, or in boxes. In the former case, be sure to have an equal number of males and females to avoid jealousies, and a few more nests than pairs in order to give them some freedom of selection.

If you want to raise finger-tame birds, as nearly everyone does, adopt the box-breeding method. The box for a single pair should be at least fourteen inches by fourteen inches by eighteen inches. An apple box or goods box of these general proportions will serve the purpose. Nail across the open end, a board one and one-half inches wide to prevent seed husks from falling out. Cover the front with three-fourths inch mesh, place a perch in convenient position, cut a door at one end, and hang a nest box on the outside at the other end. With this type of breeding cage you can fondle the young daily, and thus keep them tame.

No step in the care of your birds is more important than correct feeding. While food requirements are simple, remember that birds appreciate quality feed. Parrakeets require a seed mixture containing millets, hulled oats, and plain canary seeds. Many birds starve with full cups before them. It is well, therefore, to accept the advice of the proprietor of a pet shop, who can prescribe the proper diet.

From babyhood to old age, your feathered pets will require little care if you give them proper food and protect them against drafts.

When illness visits your aviary, be sure to keeps the birds warm both night and day until they are completely cured. Some of the more common ailments include asthma, colds, sore eyes, baldness, egg binding, broken legs, mites, scaly legs, sore feet, and diarrhoea.

MOULTING is not a disease, but is a perfectly natural annual occurrence, usually beginning in mid-summer and lasting four to six weeks. During this time, feed your birds fresh, wholesome seed.

Usually no one but the owner can be blamed when one of his feathered beauties contracts asthma, for it results usually from the inhaling of dust from stale droppings or musty seeds. This condition may be avoided by keeping the cage clean. The treatment for asthma includes two drops of iodine daily for every two ounces of the drinking water, a drop of honey applied to the inside of the throat with a feather and mentholatum in the nostrils. If after two days the bird shows improvement, omit the iodine. Feed plenty of fresh food, but only after it has been washed and dried well with a cloth.

If the little fellow sits on his perch with feathers puffed up, shivering and sneezing, he has a cold. To cure this in short order, touch the nostrils with a small bit of mentholatum on a tiny stick. Dissolve one rounded teaspoonful of Epsom salts in a pint of boiled water and give this to him in his drinking cup for two days, with nothing else to drink. Keep the little patient warm.

EGG binding may be quickly diagnosed. She will first sit on the perch, feet apart, feathers puffed and eyes strained. Later she will huddle disconsolately in one corner on the floor. An effective treatment consists of two drops of mineral oil in the mouth, with the addition of mineral oil injected in the vent. This may be given by holding the bird in the left hand on its back with the head pointing away from you, carefully injecting the medicine dropper into the vent, taking care not to break the egg, and forcing two drops of oil into the vent.

Place the little patient on a warm water bottle, with a layer of towels between bird and bottle. By removing perches and bottom from a small cage and placing the cage over bird and bottle, the latter will serve as the natural floor. Place a cloth over the cage, leaving an opening large enough to keep the bird from smothering.

Birds respond rapidly to treatment for broken legs. The best splint for this purpose is made by taking a quill feather and stripping it clean. Cut off a small piece, the length depending upon the length of the leg to be treated; split the tiny piece of quill down one side, spring it open, place the leg in it and press the quill back together. Then place the bird on the floor of a cloth covered cage, from which the perches have been removed, with food and water within reach. The bone should knit in about five days.

A good mite powder, rubbed in through the feathers, will chase away these parasites. By washing the legs in clean, warm water, drying on soft absorbent cloth, and applying a good salve, scaly legs should heal in a few days. Sore feet may result from dirt or mosquito bites. For the former, cleanliness of the premises is suggested; for the latter, in regions where mosquitos flourish, place a mosquito net around the cage at night.

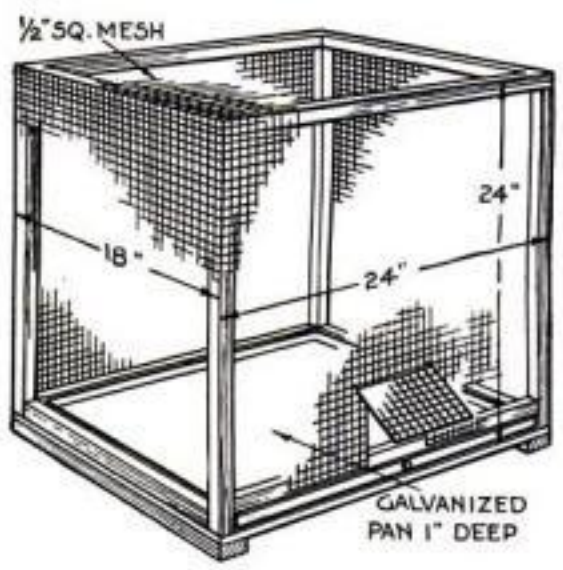


Illustration shows a homemade breeding cage that can easily be put together by anyone

Fashioned by Function!

THE AIRFLOW CHRYSLER IS THE WORLD'S FIRST BUILT-FOR-THE-PURPOSE CAR

THE functional motor car simply had to be built if motor car progress were to go on.

In 1925, average cars had 50 horsepower and made 60 miles per hour. In 1933, they had 100 horsepower, but could travel only 80. Doubling the horsepower produced only 25 per cent more speed.

Chrysler engineers discovered by wind tunnel tests that air resistance on the front of a car increases as the square of the speed. At 50 miles per hour, it is four times, not two times, as great as at 25 miles per hour.

The power required to drive the car increases as the *cube* of the speed. On a 1933 car, to overcome air resistance alone at 40 miles per hour, required seven of the available horsepower. To overcome the wind at 80, required fifty-six horsepower.

Like the airplane and the modern streamlined train, the Airflow* Chrysler is designed to cleave the air with the highest possible efficiency. It is likewise designed to give the smoothest ride over the ground . . . by the application of scientific dynamic balance.

★ ★ ★ ★

★ Redistributing weights to improve the ride . . . engine over front axle . . . passengers cradled at the center of balance.

★ Surrounding passengers with a bridgework of steel . . . making body and frame a single, vibration-proof unit.

Write for the booklet which describes the romantic development of the Floating Ride. Address Chrysler Sales Corporation, 12206 Jefferson Avenue, Detroit, Michigan.

Four Distinguished 1934 Models

CHRYSLER AIRFLOW EIGHT . . . 122 horsepower and 123-inch wheelbase. Six-passenger Sedan, Brougham and Town Sedan, five-passenger Coupe. All body types, $1245.

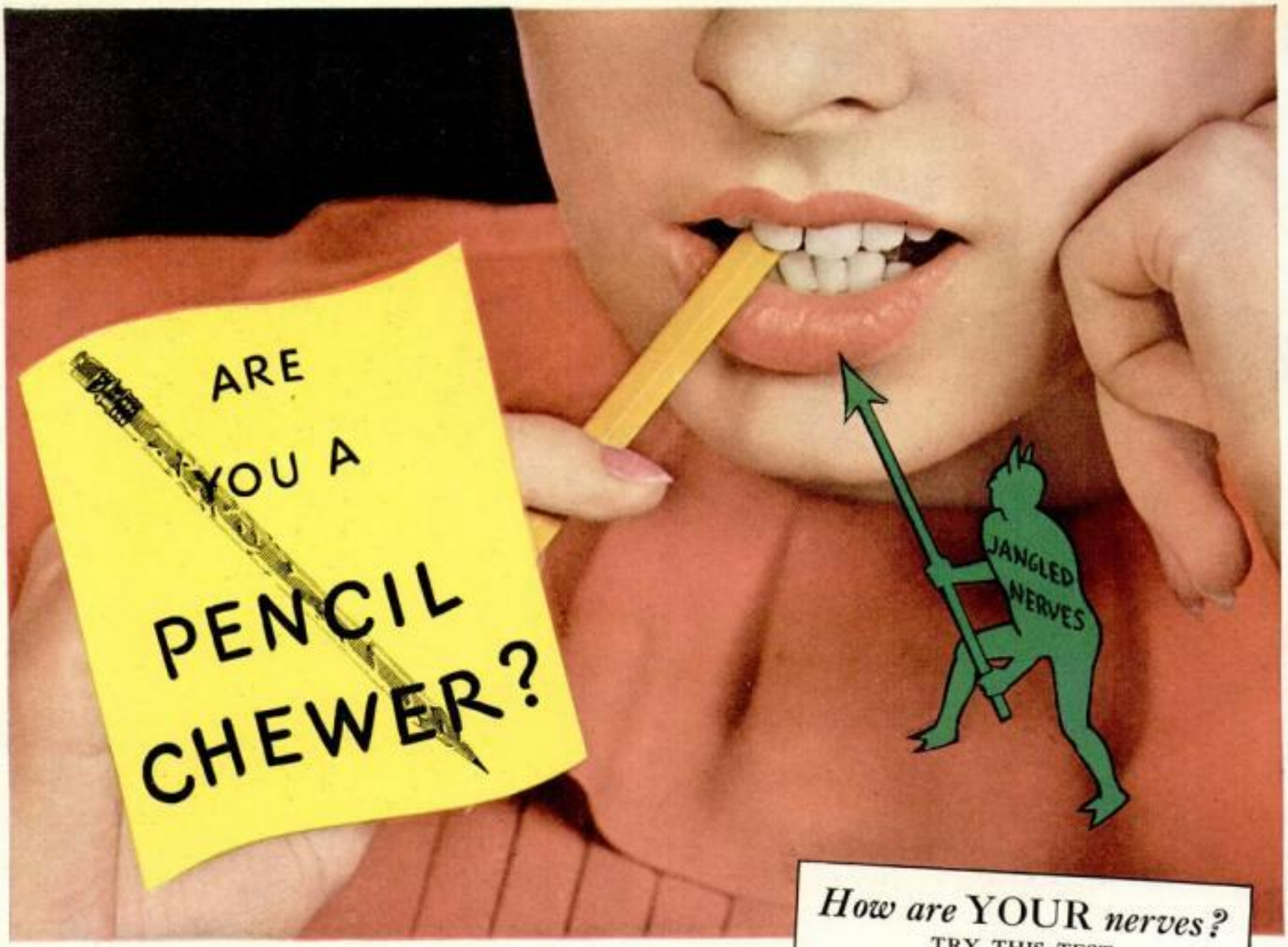
CHRYSLER AIRFLOW IMPERIAL . . . 130 horsepower . . . 128-inch wheelbase. Six-passenger Sedan and Town Sedan, five-passenger Coupe. All body types, $1495.

AIRFLOW CUSTOM IMPERIAL . . . 150 horsepower . . . 146-inch wheelbase. Individualized body types, prices on request.

1934 CHRYSLER SIX . . . *With independently sprung front wheels* . . . for a smooth, cushioned ride . . . 93 horsepower, 7 body types on 117-inch and 121-inch wheelbase. Priced from $725 up. 4-door Sedan, $795.

All Prices F. O. B. Factory, Detroit

★ ★ ★ ★



Watch out for the telltale signs of jangled nerves

Other people notice them—even when you don't—little nervous habits that are the danger signal for *jangled nerves.*

And remember, right or wrong, people put their own interpretations on them. So it pays to watch your nerves.

Get enough sleep—fresh air—recreation—and make Camels your smoke, particularly if you are a steady smoker.

For remember, Camel's costlier tobaccos never jangle your nerves—no matter how many you smoke.

How are YOUR *nerves?*

TRY THIS TEST

See how speedily you can complete this test. With your left hand (or with your right hand, if you are left-handed) unbutton your vest *beginning at the top.* Now button it again, *beginning at the top.* If you use more than *one* hand you are disqualified. Average time for six-button vest is 12 seconds.

Jack Summers (Camel smoker), national professional squash racquets champion, completed the test in 9 seconds.

COSTLIER TOBACCOS

Camels are made from finer, MORE EXPENSIVE TOBACCOS than any other popular brand of cigarettes!

CAMELS

SMOKE AS MANY AS YOU WANT

...THEY NEVER GET ON YOUR NERVES